Leica iCON gps 60
User Manual

Version 2.0
English

- when it has to be **right**

Leica Geosystems

Introduction

Purchase

Congratulations on the purchase of a Leica iCON gps 60 system.

This manual contains important safety directions as well as instructions for setting up the product and operating it. Refer to "1 Safety Directions" for further information. Read carefully through the User Manual before you switch on the product.

Product identification

The type and serial number of your product are indicated on the type plate. Always refer to this information when you need to contact your agency or Leica Geosystems authorised service workshop.

Trademarks

- Windows is a registered trademark of Microsoft Corporation in the United States and other countries
- CompactFlash and CF are trademarks of SanDisk Corporation
- Bluetooth® is a registered trademark of Bluetooth SIG, Inc.

All other trademarks are the property of their respective owners.

Validity of this manual

This manual applies to the Leica iCON gps 60 SmartAntenna.

Available documentation

Name	Description/Format		
Leica iCON gps 60 Quick Guide	Provides an overview of the product together with technical data and safety directions. Intended as a quick reference field guide.	✓	✓
Leica iCON gps 60 User Manual	All instructions required in order to operate the product to a basic level are contained in the User Manual. Provides an overview of the product together with technical data and safety directions.		✓

Refer to the following resources for all Leica iCON gps 60 documentation/software:

- the Leica USB documentation card
- https://myworld.leica-geosystems.com

myworld ©Leica Geosystems

myWorld@Leica Geosystems (**https://myworld.leica-geosystems.com**) offers a wide range of services, information and training material.
With direct access to myWorld, you are able to access all relevant services whenever it is convenient for you, 24 hours a day, 7 days per week. This increases your efficiency and keeps you and your equipment instantly updated with the latest information from Leica Geosystems.

Service	Description
myProducts	Add all Leica Geosystems products that you and your company own. View detailed information on your products, buy additional options or Customer Care Packages (CCPs), update your products with the latest software and keep up-to-date with the latest documentation.
myService	View the service history of your products in Leica Geosystems Service Centres and detailed information on the services performed on your products. For your products that are currently in Leica Geosystems Service Centres view the current service status and the expected end date of service.

Service	Description
mySupport	Create new support requests for your products that will be answered by your local Leica Geosystems Support Team. View the complete history of your Support and view detailed information on each request in case you want to refer to previous support requests.
myTraining	Enhance your product knowledge with the Leica Geosystems Campus - Information, Knowledge, Training. Study the latest online training material or download training material on your products. Keep up-to-date with the latest News on your products and register for Seminars or Courses in your country.
myTrustedServices	Offers increased productivity while at the same time providing maximum security. • myExchange With myExchange you can exchange any files/objects from your computer to any of your Leica Exchange Contacts. • mySecurity If your instrument is ever stolen, a locking mechanism is available to ensure that the instrument is disabled and can no longer be used.

Table of Contents

In this manual

1 Safety Directions

1.1 General Introduction

Description

The following directions enable the person responsible for the product, and the person who actually uses the equipment, to anticipate and avoid operational hazards.

The person responsible for the product must ensure that all users understand these directions and adhere to them.

About Warning Messages

Warning messages are an essential part of the safety concept of the instrument. They appear wherever hazards or hazardous situations can occur.

Warning messages...

- make the user alert about direct and indirect hazards concerning the use of the product.
- contain general rules of behaviour.

For the users' safety, all safety instructions and safety messages shall be strictly observed and followed! Therefore, the manual must always be available to all persons performing any tasks described herein.

DANGER, **WARNING**, **CAUTION** and **NOTICE** are standardized signal words for identifying levels of hazards and risks related to personal injury and property damage. For your safety it is important to read and fully understand the table below with the different signal words and their definitions! Supplementary safety information symbols may be placed within a warning message as well as supplementary text.

Type	Description
DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in appreciable material, financial and environmental damage.
☞	Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

1.2 Definition of Use

Intended use

- Computing with software.
- Carrying out measurement tasks using various GNSS measuring techniques.
- Recording GNSS and point related data.
- Remote control of product.
- Data communication with external appliances.
- Measuring raw data and computing coordinates using carrier phase and code signal from GNSS satellites.

Reasonably foreseeable misuse

- Use of the product without instruction.
- Use outside of the intended use and limits.
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools, for example screwdriver, unless this is permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with recognisable damages or defects.
- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.
- Inadequate safeguards at the working site.
- Controlling of machines, moving objects or similar monitoring application without additional control- and safety installations.

1.3 Limits of Use

Environment

Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments.

⚠ DANGER

Local safety authorities and safety experts must be contacted before working in hazardous areas, or close to electrical installations or similar situations by the person in charge of the product.

1.4 Responsibilities

Manufacturer of the product

Leica Geosystems AG, CH-9435 Heerbrugg, hereinafter referred to as Leica Geosystems, is responsible for supplying the product, including the user manual and original accessories, in a safe condition.

Person responsible for the product

The person responsible for the product has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual.
- To ensure that it is used in accordance with the instructions.
- To be familiar with local regulations relating to safety and accident prevention.
- To inform Leica Geosystems immediately if the product and the application becomes unsafe.
- To ensure that the national laws, regulations and conditions for the operation of e.g. radio transmitters or lasers are respected.

1.5 Hazards of Use

CAUTION

Watch out for erroneous measurement results if the product has been dropped or has been misused, modified, stored for long periods or transported.

Precautions:

Periodically carry out test measurements and perform the field adjustments indicated in the user manual, particularly after the product has been subjected to abnormal use and before and after important measurements.

DANGER

Because of the risk of electrocution, it is dangerous to use poles and extensions in the vicinity of electrical installations such as power cables or electrical railways.

Precautions:

Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.

WARNING

During dynamic applications, for example stakeout procedures there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around, for example obstacles, excavations or traffic.

Precautions:

The person responsible for the product must make all users fully aware of the existing dangers.

WARNING

Inadequate securing of the working site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.

Precautions:

Always ensure that the working site is adequately secured. Adhere to the regulations governing safety and accident prevention and road traffic.

CAUTION

If the accessories used with the product are not properly secured and the product is subjected to mechanical shock, for example blows or falling, the product may be damaged or people can sustain injury.

Precautions:

When setting-up the product, make sure that the accessories are correctly adapted, fitted, secured, and locked in position.

Avoid subjecting the product to mechanical stress.

WARNING

If the product is used with accessories, for example masts, staffs, poles, you may increase the risk of being struck by lightning.

Precautions:

Do not use the product in a thunderstorm.

DANGER

If the product is used with accessories, for example on masts, staffs, poles, you may increase the risk of being struck by lightning. Danger from high voltages also exists near power lines. Lightning, voltage peaks, or the touching of power lines can cause damage, injury and death.

Precautions:

- Do not use the product in a thunderstorm as you can increase the risk of being struck by lightning.
- Be sure to remain at a safe distance from electrical installations. Do not use the product directly under or close to power lines. If it is essential to work in such an environment contact the safety authorities responsible for electrical installations and follow their instructions.
- If the product has to be permanently mounted in an exposed location, it is advisable to provide a lightning conductor system. A suggestion on how to design a lightning conductor for the product is given below. Always follow the regulations in force in your country regarding grounding antennas and masts. These installations must be carried out by an authorised specialist.
- To prevent damages due to indirect lightning strikes (voltage spikes) cables, for example for antenna, power source or modem should be protected with appropriate protection elements, like a lightning arrester. These installations must be carried out by an authorised specialist.
- If there is a risk of a thunderstorm, or if the equipment is to remain unused and unattended for a long period, protect your product additionally by unplugging all systems components and disconnecting all connecting cables and supply cables, for example, instrument - antenna.

Lightning conductors

Suggestion for design of a lightning conductor for a GNSS system:

1) On non-metallic structures

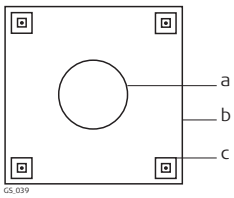
   Protection by air terminals is recommended. An air terminal is a pointed solid or tubular rod of conducting material with proper mounting and connection to a conductor. The position of four air terminals can be uniformly distributed around the antenna at a distance equal to the height of the air terminal.

   The air terminal diameter should be 12 mm for copper or 15 mm for aluminium. The height of the air terminals should be 25 cm to 50 cm. All air terminals should be connected to the down conductors. The diameter of the air terminal should be kept to a minimum to reduce GNSS signal shading.

2) On metallic structures

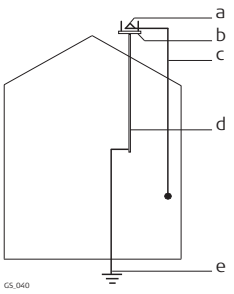
   Protection is as described for non-metallic structures, but the air terminals can be connected directly to the conducting structure without the need for down conductors.

Air terminal arrangement, plan view



a) Antenna
b) Support structure
c) Air terminal

Grounding the instrument/antenna



a) Antenna
b) Lightning conductor array
c) Antenna/instrument connection
d) Metallic mast
e) Connection to earth

CAUTION

During the transport, shipping or disposal of batteries it is possible for inappropriate mechanical influences to constitute a fire hazard.

Precautions:

Before shipping the product or disposing of it, discharge the batteries by running the product until they are flat.

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping contact your local passenger or freight transport company.

WARNING

High mechanical stress, high ambient temperatures or immersion into fluids can cause leakage, fire or explosions of the batteries.

Precautions:

Protect the batteries from mechanical influences and high ambient temperatures. Do not drop or immerse batteries into fluids.

WARNING

If battery terminals are short circuited e.g. by coming in contact with jewellery, keys, metalized paper or other metals, the battery can overheat and cause injury or fire, for example by storing or transporting in pockets.

Precautions:

Make sure that the battery terminals do not come into contact with metallic objects.

WARNING

Incorrect fastening of the external antenna to vehicles or transporters poses the risk of the equipment being broken by mechanical influence, vibration or airstream. This may result in accident and physical injury.

Precautions:

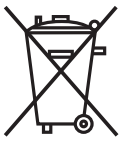
Attach the external antenna professionally. The external antenna must be secured additionally, for example by use of a safety cord. Ensure that the mounting device is correctly mounted and able to carry the weight of the external antenna (>1 kg) safely.

WARNING

If the product is improperly disposed of, the following can happen:

- If polymer parts are burnt, poisonous gases are produced which may impair health.
- If batteries are damaged or are heated strongly, they can explode and cause poisoning, burning, corrosion or environmental contamination.
- By disposing of the product irresponsibly you may enable unauthorised persons to use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination.

Precautions:



The product must not be disposed with household waste.

Dispose of the product appropriately in accordance with the national regulations in force in your country.

Always prevent access to the product by unauthorised personnel.

Product-specific treatment and waste management information can be downloaded from the Leica Geosystems home page at http://www.leica-geosystems.com/treatment or received from your Leica Geosystems dealer.

WARNING

Only Leica Geosystems authorised service workshops are entitled to repair these products.

1.6 Electromagnetic Compatibility EMC

Description

The term Electromagnetic Compatibility is taken to mean the capability of the product to function smoothly in an environment where electromagnetic radiation and electrostatic discharges are present, and without causing electromagnetic disturbances to other equipment.

WARNING

Electromagnetic radiation can cause disturbances in other equipment.

Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed.

CAUTION

There is a risk that disturbances may be caused in other equipment if the product is used with accessories from other manufacturers, for example field computers, personal computers or other electronic equipment, non-standard cables or external batteries.

Precautions:

Use only the equipment and accessories recommended by Leica Geosystems. When combined with the product, they meet the strict requirements stipulated by the guidelines and standards. When using computers or other electronic equipment, pay attention to the information about electromagnetic compatibility provided by the manufacturer.

CAUTION

Disturbances caused by electromagnetic radiation can result in erroneous measurements.

Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that the product may be disturbed by intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generators.

Precautions:

Check the plausibility of results obtained under these conditions.

CAUTION

If the product is operated with connecting cables attached at only one of their two ends, for example external supply cables, interface cables, the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other products may be impaired.

Precautions:

While the product is in use, connecting cables, for example product to external battery, product to computer, must be connected at both ends.

Radios or digital cellular phones

Use of product with radio or digital cellular phone devices:

WARNING

Electromagnetic fields can cause disturbances in other equipment, in installations, in medical devices, for example pacemakers or hearing aids and in aircraft. It can also affect humans and animals.

Precautions:
Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment can be disturbed or that humans or animals can be affected.

- Do not operate the product with radio or digital cellular phone devices in the vicinity of filling stations or chemical installations, or in other areas where an explosion hazard exists.
- Do not operate the product with radio or digital cellular phone devices near to medical equipment.
- Do not operate the product with radio or digital cellular phone devices in aircraft.

1.7 FCC Statement, Applicable in U.S.

The greyed paragraph below is only applicable for products without radio, digital cellular phone devices.

WARNING

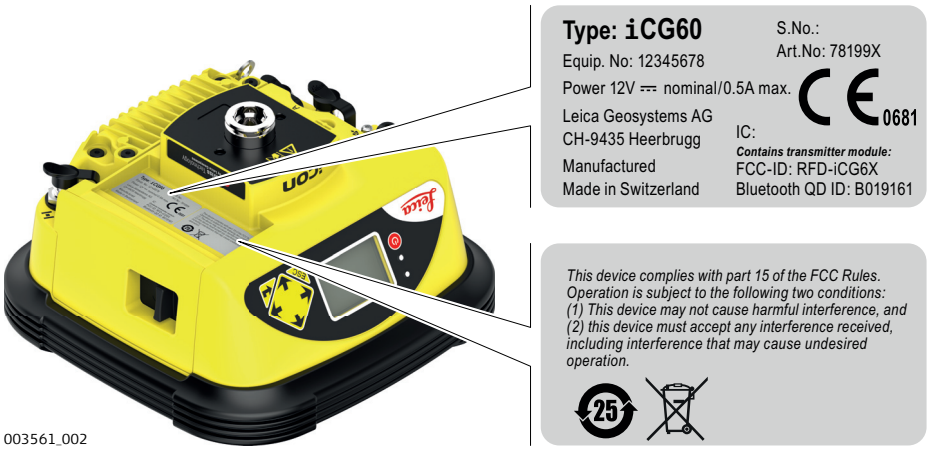
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules.
These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

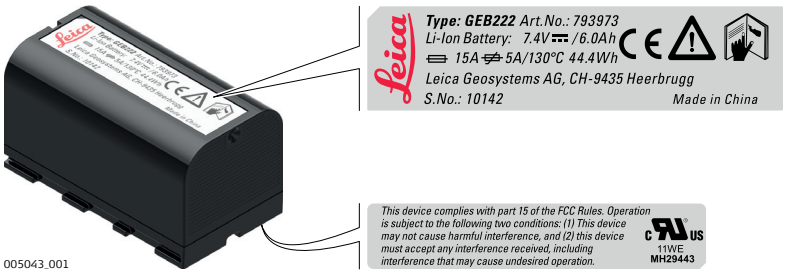
WARNING

Changes or modifications not expressly approved by Leica Geosystems for compliance could void the user's authority to operate the equipment.

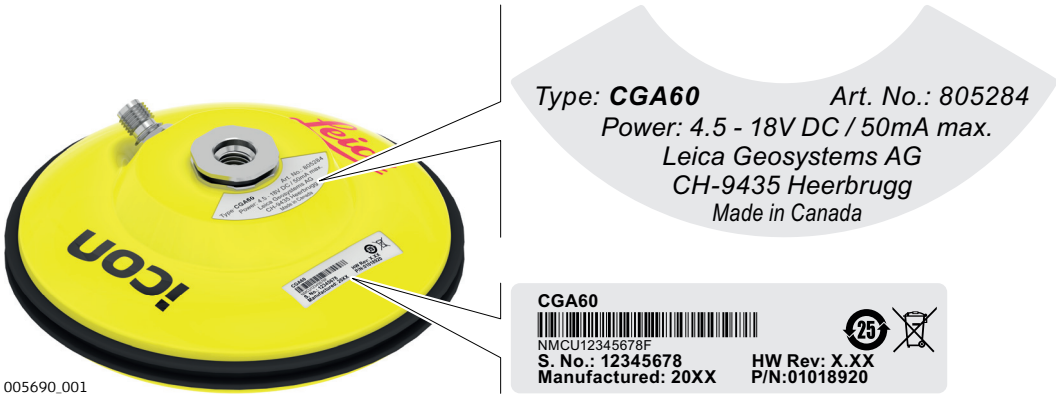
Labelling iCON gps 60 SmartAntenna



Labelling internal battery GEB222



Labelling CGA60



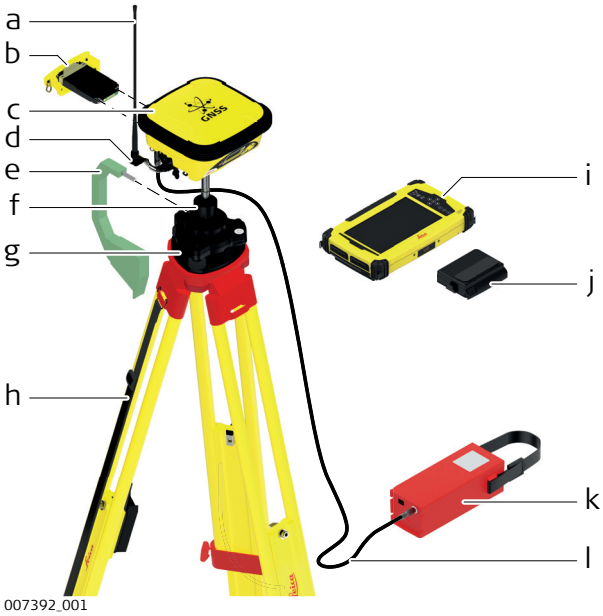
2 Description of the System

2.1 System Components

Description

The Leica iCON gps 60 SmartAntenna together with dedicated accessories like the Field Controllers, the Leica CGA60 GNSS antenna, a machine computer, or an external radio offers you highest productivity and flexibility. For example, a Base Station configuration as well as Rover configuration is possible, but the system also can be used in a Machine configuration.
Two example configurations are shown in the following paragraphs.

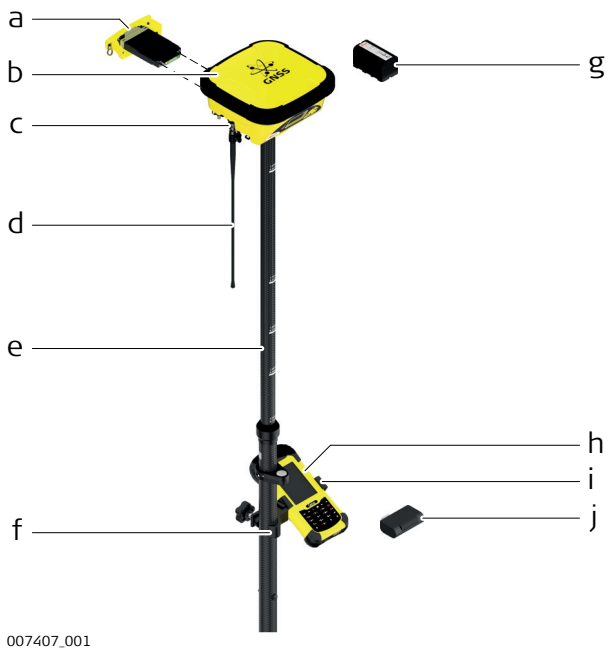
Main components, Base Station configuration



a) Radio antenna
b) Satel Radio CCD7
c) iCON gps 60 SmartAntenna
d) GAD108 Antenna arm
e) GSZ4-1 Height hook
f) GRT146 Carrier
g) Tribrach
h) Tripod
i) CC60/CC61/CC65/CC66 Field Controller
j) Battery for Field Controller
k) GEB171 external battery
l) GEV219 power cable

Component	Description
iCON gps 60 Smart-Antenna	To calculate the position from the computed ranges to all visible GNSS (**G**lobal **N**avigation **S**atellite **S**ystem) satellites.
Field Controller	Compatible controllers running iCON field software can be used to operate the iCON gps 60 SmartAntenna.
Satel radio CCD7	For long-range data transmission.
Radio antenna	The use of an external radio antenna maximises radio coverage.
Tripod, tribrach, carrier	To setup the instrument as a Base Station.

Main components, Rover configuration



a) Satel Radio CCD7
b) iCON gps 60 SmartAntenna
c) GAD109 QN/TNC adapter
d) Radio antenna
e) Pole
f) Pole clamp
g) GEB221/GEB222 battery
h) CC50/CC55 Field Controller
i) Holder for Field Controller
j) Battery for Field Controller

Component	Description
iCON gps 60 Smart-Antenna	To calculate the position from the computed ranges to all visible GNSS (**G**lobal **N**avigation **S**atellite **S**ystem) satellites.
Field Controller	Compatible controllers running iCON field software can be used to operate the iCON gps 60 SmartAntenna.
Satel radio CCD7	For long-range data transmission.
Radio antenna	The use of an external radio antenna maximises radio coverage.
Pole, pole clamp, holder for Field Controller	To setup the instrument as a Rover.

Instrument channels and satellite tracking

- Up to 16 satellites in continuous tracking on L1, L2 and L5 (GPS).
- Up to 14 satellites in continuous tracking on L1 and L2 (GLONASS).
- Up to 14 satellites in continuous tracking on E1, E5a, E5b and Alt-BOC (Galileo).
- Four satellites when tracking SBAS (EGNOS, WAAS, MSAS, GAGAN).

☞ Depending on the satellite systems and signals configured, a maximum number of 120 channels is allocated.

☞ Once the first operational Galileo satellites are available, a software update will be required.

☞ The iCON gps 60 SmartAntenna is additionally designed to support BeiDou, however a future SW upgrade is required.

Special features iCON gps 60 Smart-Antenna

iCON gps 60 SmartAntenna is equipped with several special features:

- Wide supply voltage range of 9 V to 28 V
- Voltage peak protection and reverse polarity protection
- Can be used on a machine when being mounted inside the cabin
- Can be used near the sea
- Protection caps on connectors
- Display and keys for status and configuration
- Versatile connectivity including USB, Serial RS232, Ethernet and Bluetooth
- USB host port for data transfer and firmware upgrade
- Integrated high speed HSPA (3.5G) / GPRS (2G) modem for countries without 3G
- Integrated radio options
- Backwards compatibility: supports external GFU communication devices for cost effective upgrade from legacy Leica systems
- Robust, compact plastic housing

Special features CGA60

CGA60 antennas are equipped with several special features:

- Can be used near the sea
- Standard robust 5/8" Whitworth thread
- Robust TNC connector
- Future proof four constellation, triple frequency antenna element
- Robust, compact plastic housing

Commands for Remote Control

The iCON gps 60 SmartAntenna can be communicated with via the MPI protocol on the serial port P1. Documentation for that communication protocol is available on request from the Leica Geosystems representative.

2.2 Unpacking the Container

Description

Available delivery packages:

- A hard-top container comprising all items for a GNSS Rover setup.
- Different hard-top containers comprising all items for a Base Station setup, including various Field Controllers.

2.2.1 Base Station Container

CTC1 Container upper shell

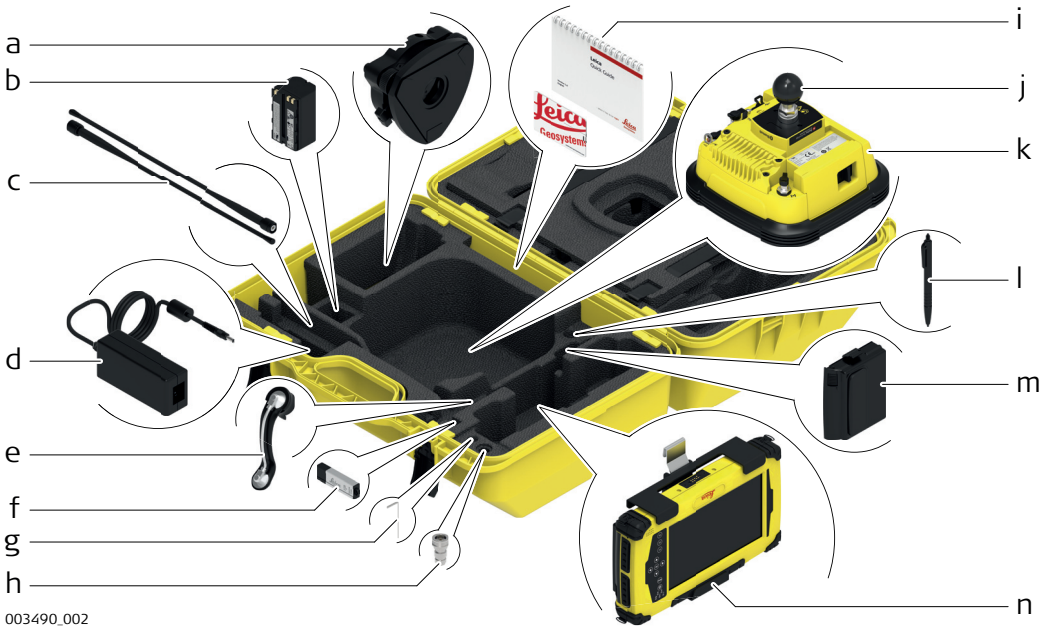
The large-size CTC1 container comprises all items for the Base Station setup. The content of the upper shell is the same for all available container configuration.

003489_002

a) CGA60 Robust triple frequency GNSS antenna
b) GFU modem
c) GSZ4-1 Height hook
d) Cable set
e) GHT36 Base for telescopic rod
f) GHT58 Tripod bracket for GFU housing
g) GAD34 Arm, adapter antenna to extension
h) GRT146 Carrier

CTC1 container lower shell - iCON CC60/CC61/CC65/ CC66

Large-size CTC1 container configuration with iCON CC60/CC61/CC65/CC66 Field Controller.



a) Tribrach
b) GEB221/GEB222 Battery
c) Radio antennas
d) AC-adapter for Field Controller
e) GAD108 Antenna arm
f) MS1 Industrial 1 GB USB memory stick
g) Allen key
h) QN/TNC adapter
i) Manuals & USB documentation card
j) Ball mount
k) iCON gps 60 SmartAntenna
l) Spare stylus for Field Controller
m) Spare battery for Field Controller
n) CC60/CC61/CC65/CC66 Field Controller

CTC1 container lower shell - iCON CC50/CC55

Large-size CTC1 container configuration with iCON CC50/CC55 Field Controller.

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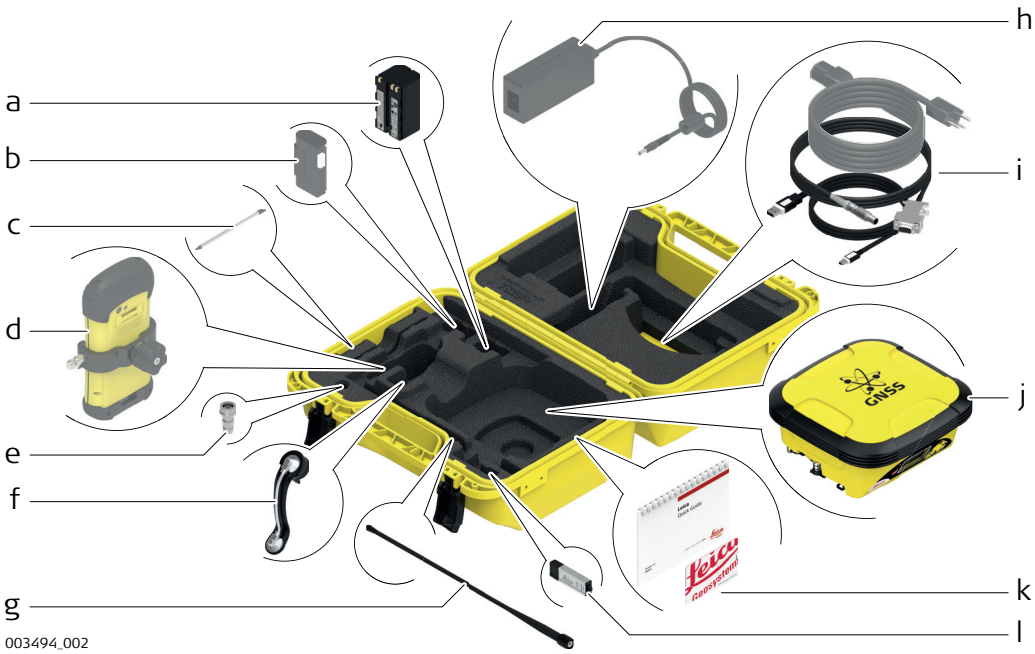
a) Tribrach
b) GEB221/GEB222 Battery
c) Radio antennas
d) AC-adapter for Field Controller
e) GAD108 Antenna arm
f) MS1 Industrial 1 GB USB memory stick
g) Allen key
h) QN/TNC adapter
i) Manuals & USB documentation card
j) Ball mount
k) iCON gps 60 SmartAntenna
l) Spare stylus for Field Controller
m) Spare battery for Field Controller
n) CC50/CC55 Field Controller

CTC2 container - iCON gps 60 Smart-Antenna

The small-size CTC2 container comprises the iCON gps 60 SmartAntenna and its accessories.

☞ The container can additionally hold a iCON CC50/CC55 Field Controller with accessories.



a) GEB221/GEB222 Battery
b) Spare battery for Field Controller*
c) Spare stylus for Field Controller*
d) CC50/CC55 Field Controller*
e) QN/TNC adapter
f) GAD108 Antenna arm
g) Radio antenna
h) AC-adapter for Field Controller*
i) Cable set
j) iCON gps 60 SmartAntenna
k) Manuals & USB documentation card
l) MS1 Industrial 1 GB USB memory stick

* optional accessory

iCON gps 60 Smart-Antenna components

a) User interface, including ON/OFF button
b) USB data port
c) Antenna connector (QN)
d) LEMO connector (serial)
e) Whitworth thread, 5/8"
f) Radio cover
g) Battery holder
h) Antenna connector (TNC)

Element	Function
USB 2.0	USB A data port, for data exchange, software updates.
LEMO connector (8-pin, female)	RS232 for connection of external power supply, data in/out or external radio.
Antenna connector (TNC)	For connection of an external GNSS antenna, for example CGA60 for reference setup and machine use case.
Antenna connector (QN)	For connection of an external radio antenna.

CGA60 components

a) Whitworth thread, 5/8"
b) Mechanical reference plane
c) TNC female connector

2.4 Compatible Field Controllers

About the controllers

☞ The iCON gps 60 SmartAntenna can be used as a standalone device or in combination with compatible controllers running iCON field software.

2.4.1 Available Field Controller

CC50/CC55 upside

a) SD-card slot
b) Status LEDs
c) Screen
d) Keyboard
e) Power button
f) Serial connector
g) Mini-USB connector
h) Docking connector
i) Power connector

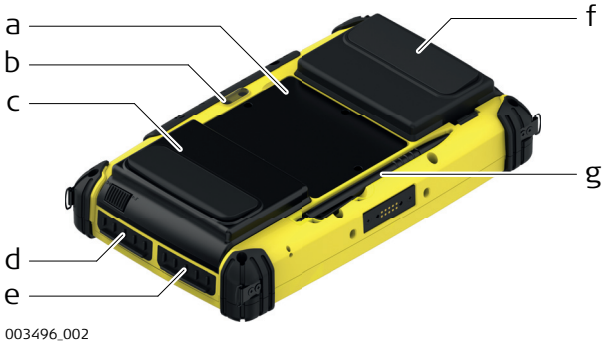
CC50/CC55 rear side

a) Camera lens
b) Hand strap clip
c) Stylus
d) Speaker
e) Battery and SIM-card compartment

CC60/CC61/CC65/ CC66 upside

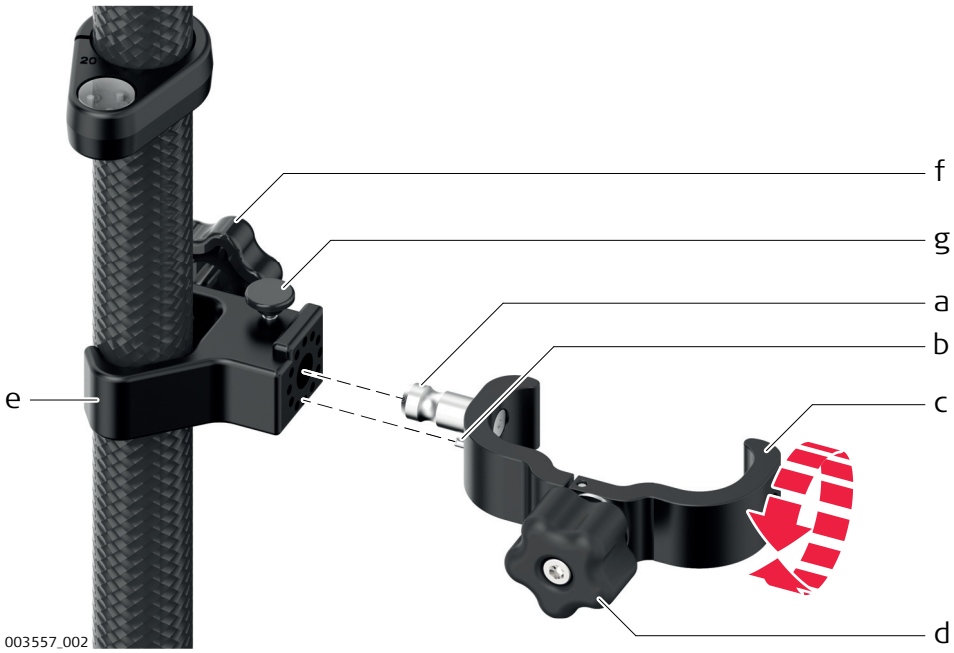
a) Screen
b) D-SUB 9 port
c) USB host port for USB stick
d) Keyboard
e) Speaker
f) Docking station contacts

CC60/CC61/CC65/ CC66 rear side



a) SIM card slot
b) Digital camera
c) Battery compartment L
d) Micro in, Audio out and LAN
e) Power socket and USB host port for USB stick
f) Battery compartment R
g) Stylus

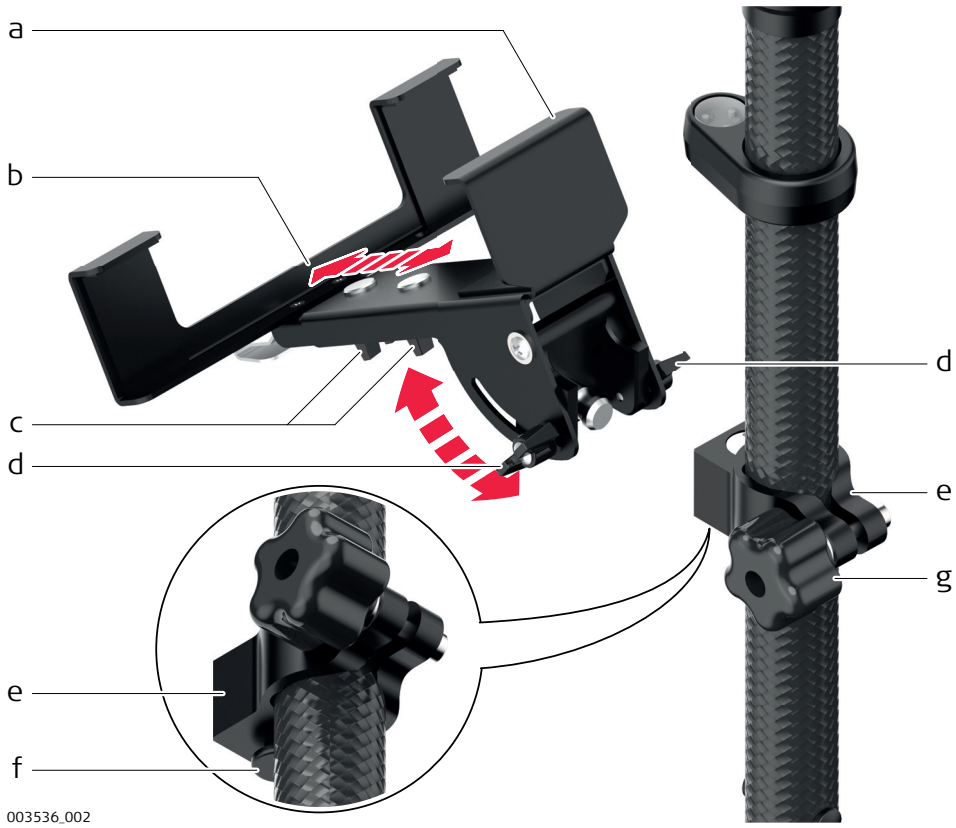
Holder for iCON CC50/CC55



Holder:
a) Mounting pin
b) Positioning pin
c) Instrument holder
d) Tightening screw

Clamp:
e) Pole clamp
f) Tightening screw
g) Unlocking bolt

Holder for iCON CC60/CC61/CC65/ CC66



Holder:

a) Upper holder (fixed)
b) Lower holder (extendable)
c) Fixation screws (size adjustment)
d) Fixation screws (angle adjustment)

Clamp:

e) Pole clamp
f) Unlocking bolt
g) Tightening screw

The iCON site/iCON build Field Software is the recommended software on the compatible Field Controllers to run the iCON gps 60 SmartAntenna. Sole Base Station and Rover use is also possible with the on-board software.

iCON site software - main menu at a glance

Refer to the iCON site software and documentation for further information.

iCON build software - main menu at a glance

Refer to the iCON build software and documentation for further information.

3 Using the iCON gps 60 SmartAntenna

3.1 Power Supply

General

Use the batteries, chargers and accessories recommended by Leica Geosystems to ensure the correct functionality of the instrument.

- The battery must be charged before using it for the first time.
- For new batteries or batteries that have been stored for more than 3 month, one charge and discharge cycle is recommended.

Internal and external power supply

Power for the instrument can be supplied by the internal GEB221/GEB222 battery or externally.
External power can be supplied by:

- 9 V to 28 V DC power supply (machine or vehicle) via a converter cable supplied by Leica Geosystems.
- GEB171 battery connected via a cable.
- 110 V/240 V AC to 12 V DC power supply unit, supplied by Leica Geosystems.

External power for the iCON gps 60 SmartAntenna can be supplied using the LEMO port.

The iCON gps 60 SmartAntenna can use internal and external power supply in parallel.

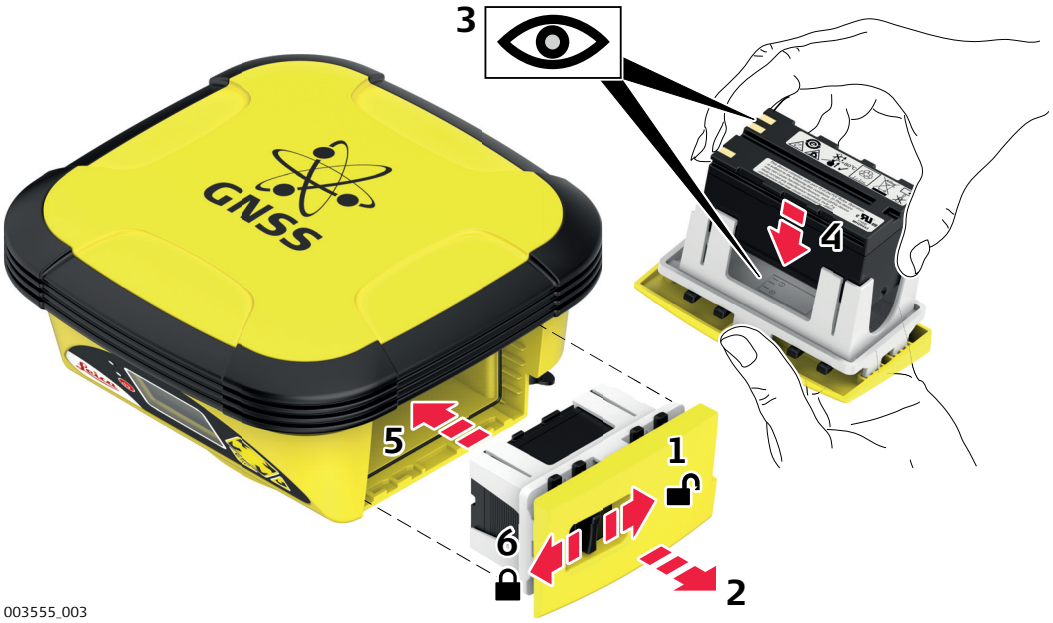
For permanent operations use **U**ninterruptible **P**ower **S**upply units as a back-up in a main power failure.

In general, all installation works - including the setting up of a permanent power supply - must be done by a dedicated installation specialist. Please contact the local selling unit or dealer for further information.

3.2 Batteries

3.2.1 Installing the Internal Battery

Insert and remove the battery step-by-step



003555_003

Step	Description
☞	Ensure the instrument is placed on a stable surface.
1.	Push the slide fastener in the direction of the arrow with the open-lock symbol.
2.	Pull out the battery holder.
3.	Orientate the battery to match with the pictogram on the base of the holder!
4.	Insert the battery into the holder. Check that the battery is locked in!
5.	Push the holder with battery into the battery compartment.
6.	Close the battery compartment by pushing the slide fastener in the direction of the arrow with the close-lock symbol.

3.2.2 General Battery Handling

First-time use / Charging batteries

- The battery must be charged prior to using it for the first time.
- The permissible temperature range for charging is between 0°C to +40°C/ +32°F to +104°F. For optimal charging, we recommend charging the batteries at a low ambient temperature of +10°C to +20°C/+50°F to +68°F if possible.
- It is normal for the battery to become warm during charging. Using the chargers recommended by Leica Geosystems, it is not possible to charge the battery if the temperature is too high.
- For Li-Ion batteries, a single refreshing cycle is sufficient. We recommend carrying out a refreshing cycle when the battery capacity indicated on the charger or on a Leica Geosystems product deviates significantly from the actual battery capacity available.

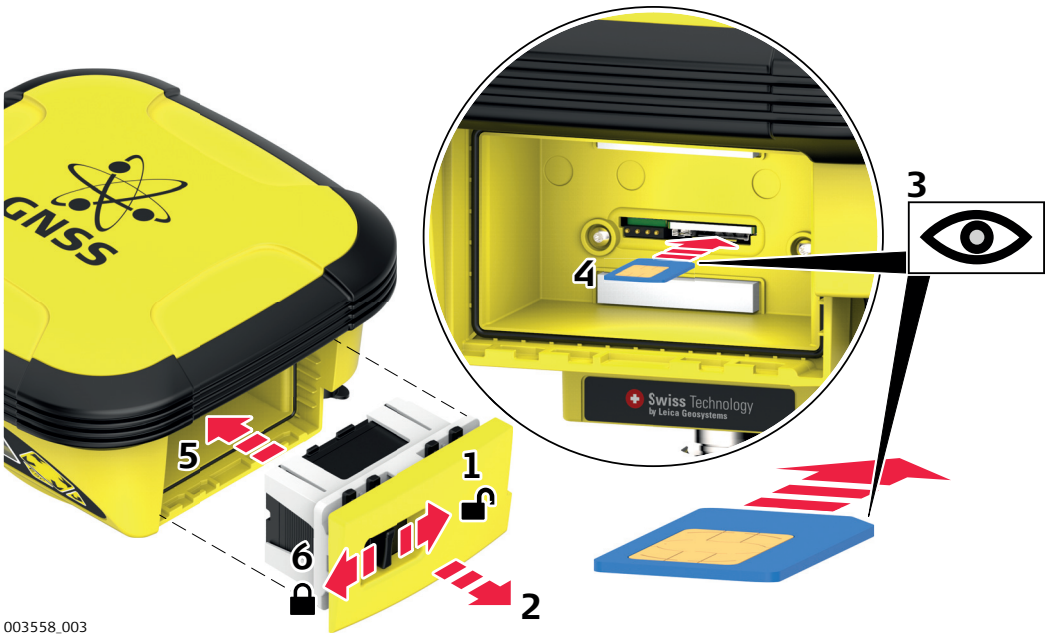
Operation / Discharging

- The batteries can be operated from -20°C to +55°C/-4°F to +131°F.
- Low operating temperatures reduce the capacity that can be drawn; high operating temperatures reduce the service life of the battery.

- Keep the card dry.
- Use it only within the specified temperature range.
- Do not bend the card.
- Protect the card from direct impacts.

Failure to follow these instructions could result in data loss and/or permanent damage to the card.

Insert and remove the SIM card step-by-step



Step	Description
☞	Ensure the instrument is placed on a stable surface.
1.	Push the slide fastener in the direction of the arrow with the open-lock symbol.
2.	Pull out the battery holder.
3.	Orientate the SIM card as illustrated.
4.	Insert the SIM card into the card slot and push it in until it locks in place.
5.	Insert the battery holder. Check for proper seating!
6.	Close the battery compartment by pushing the slide fastener in the direction of the arrow with the close-lock symbol.

3.4 Slot-in-Device

Internal radios

Following internal radios can be used with the instrument:

Radio	Device
Satel TA13	CCD7
Intuicom 900SLR	CCD8

☞ Please contact the local selling unit or dealer for information about exchanging the internal radio.

3.5 External Radios

External Radio Devices

Following external radios can be used with the instrument using a cable connection:

- Intuicom 1200DL, transceive
- Pacific Crest PDL, receive
- Pacific Crest ADL, transceive
- Satelline 3AS, transceive
- Satelline M3-TR1, transceive
- TFR-300L, receive

Pacific Crest radio modems

Pacific Crest radio modems must be ordered directly from your local Pacific Crest Office or Representative.

PDL receive only modems built into the Leica GFU radio housing with 12.5 or 25 kHz channel spacing within the following frequency bands are available:

- 410 - 430 MHz
- 430 - 450 MHz
- 450 - 470 MHz
- 223 - 235 MHz

Insert and remove a USB Memory device step-by-step

007394_001

Step	Description
☞	Ensure the instrument is placed on a stable surface.
1.	Detach the USB port cover.
2.	Slide the USB Memory device firmly into the USB host port into position.
☞	Take care not to damage the USB Memory device when moving the iCON gps 60 SmartAntenna or when handling around the device.
☞	It's recommended to close the USB port cover when no USB Memory device is used.

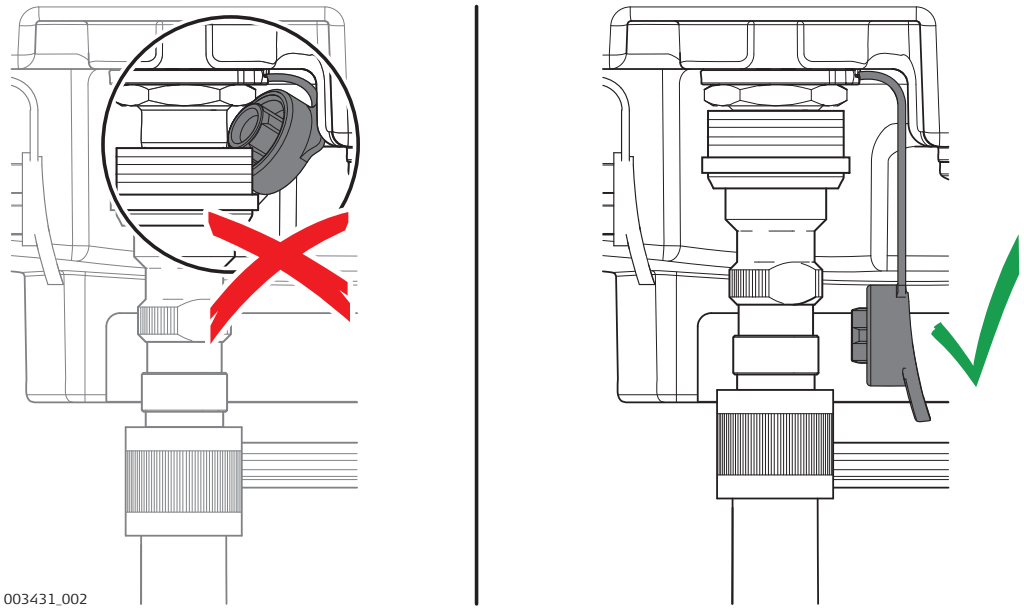
Preconditions for using USB Memory devices

- USB Memory devices must be formatted in the FAT or FAT32 format.
- To import data from a USB Memory device to the iCON gps 60 SmartAntenna appropriate folders must be created on the USB device and the files placed in the correct folder. Refer to "6.6 Import, Export, or Delete Data" for further information.

Installing a TNC adapter

A TNC adapter can be plugged onto the QN connector to attach external radio antennas.

☞ Make sure the rubber cap of the QN adapter does not get squeezed inbetween the iCON gps 60 SmartAntenna housing and the TNC adapter!



3.8 Installation on a Machine

☞ In general, all installation works must be done by a dedicated installation specialist. Please contact the local selling unit or dealer for further information.
The installation information within this User Manual is indicated to increase the operators understanding of the system and its maintaining.

☞ Before installation:

- Please observe the maximum vibration and ambient temperature values indicated in chapter "9 Technical Data".
- Check that all parts needed are delivered. Refer to "2.2 Unpacking the Container" for further information.
- It is strongly recommended that you bench test all components before commencing installation on the actual machine to make sure that all components are fully operational.

iCON gps 60 SmartAntenna Installation location

The iCON gps 60 SmartAntenna must be installed in the machine cabin itself. For easy mounting the optional Machine Bracket CMB3 is recommended.

☞ The product must not be installed on the tool of the machine and/or on mechanical components that move the tool. Tools include for example bucket of excavator, blade of dozer, screed of paver. Mechanical parts include for example boom and stick of an excavator, hydraulic cylinder of a dozer or tow arm of an asphalt paver.
Further, the instrument must not be installed near chassis, chain gear, wheels or on engine components connected to the engine itself. The cases stated are intended simply as examples.
The instrument must not be installed on a mast as well.

Installation of a CGA60 GNSS antenna

For best results, it is recommended to mount the GNSS antenna in a way ensuring an unobstructed view of the sky.

Installation of external radio

A special bracket for proper mounting of the external GFU radio can be used.
GFU bracket: MMB1250, GFU Bracket on Machine

Installation of antennas for internal/external radios and modems

- External antennas with a magnetic mount can be used and installed on the roof of the cabin.
- This will increase the radio signal and therefore the reception of correction signals from a base station or when using a NTRIP solution.

Cable installation

- Ensure that the cables between iCON gps 60 SmartAntenna and CGA60 antenna in particular are installed so as to prevent them from becoming bent and stretched.
- It is strongly recommended to use strain relief brackets.
- Route the cable as directly as possible and avoid crossing cables.
- Be sure not to tie the cables into “hot” hydraulic hoses.

3.9 Antenna Heights

3.9.1 Understanding Antenna Heights

Description

The height of the GNSS antenna above a point consists of three components:
- the vertical height reading,
- the vertical offset,
- the vertical phase centre variations.

For most operations, pre-configured standard settings in the instrument can be used. They automatically take the vertical phase centre variations into account.

MRP

The antenna accepts vertical height readings to the **M**echanical **R**eference **P**lane, MRP.

Vertical phase centre variations

These are handled automatically in the standard antenna records. The antenna calibrations to determine the phase centre variations were executed by Geo++® GmbH.

☞ **Pillar setup**. For other than the GRT146 carrier, the dimensions must be determined and the vertical offset must be adapted.

☞ **Tripod setup**. For height measurement devices other than the height hook, the dimensions must be determined and the vertical offset must be adapted.

☞ **Pole setup**. For other than Leica poles, the dimensions must be determined.

☞ **Mast setup**. The dimensions of the mast must be determined.

3.9.2 The Mechanical Reference Plane, MRP

Description

The **M**echanical **R**eference **P**lane:
- is where the instrument heights are measured to.
- is where the phase centre variations refer to.
- varies for different instruments.

MRP of the antenna

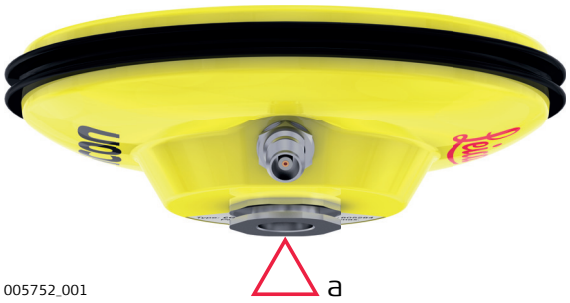
The MRP for the antenna is shown in the diagram.

003497_002

a) The mechanical reference plane is the underside of the threaded metal insert.

MRP of the antenna

The MRP for the CGA60 antenna is shown in the diagram.

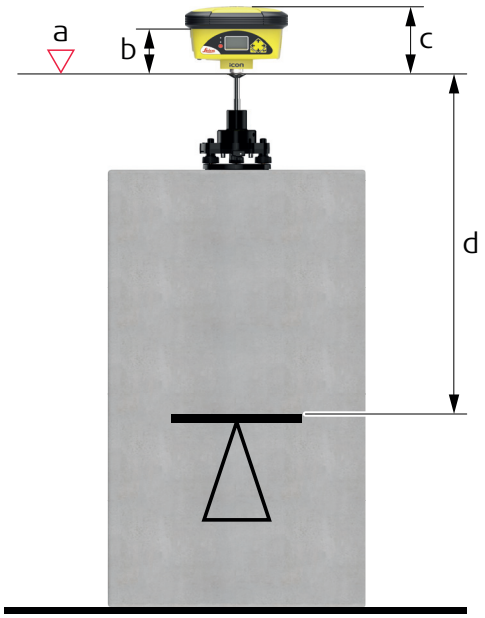


a) The mechanical reference plane is the underside of the threaded metal insert.

3.9.3 Measuring the Antenna Height for a Pillar Setup

Measuring the antenna height - pillar setup

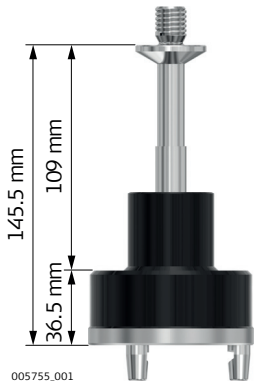
Setup type	Antenna name	The required measurement
Pillar	iCON gps 60 SmartAntenna	the vertical height reading to the MRP.



a) Mechanical reference plane MRP
b) Vertical phase centre offset for L1
c) Vertical phase centre offset for L2
d) **Vertical Height Reading**

No vertical offset.

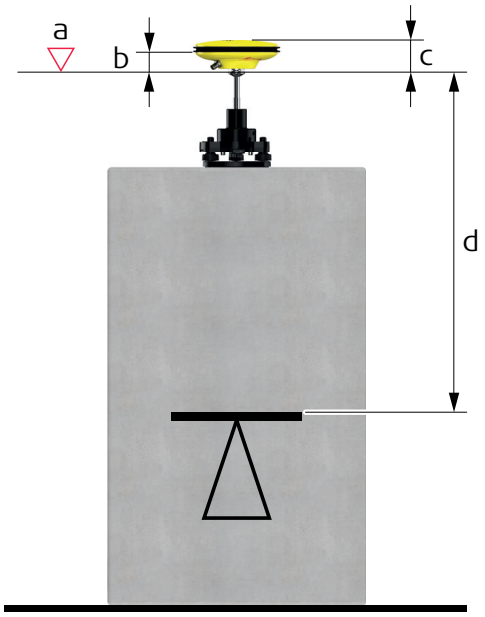
Determining the antenna height with the GRT146 carrier step-by-step

Step	Description
1.	Measure a height from the pillar benchmark to a surface on the carrier. 
2.	Use the appropriate measurement from the diagram above. Determine the height difference between the measured surface on the carrier and where the MRP of the antenna sits on the carrier.

Step	Description
3.	The vertical height reading = adding the values in step 1. and step 2.

Measuring the antenna height - pillar setup

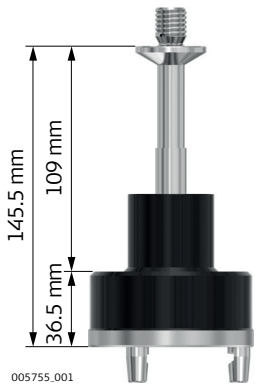
Setup type	Antenna name	The required measurement
Pillar	CGA60	the vertical height reading to the MRP.



a) Mechanical reference plane MRP
b) Vertical phase centre offset for L1
c) Vertical phase centre offset for L2
d) **Vertical Height Reading**

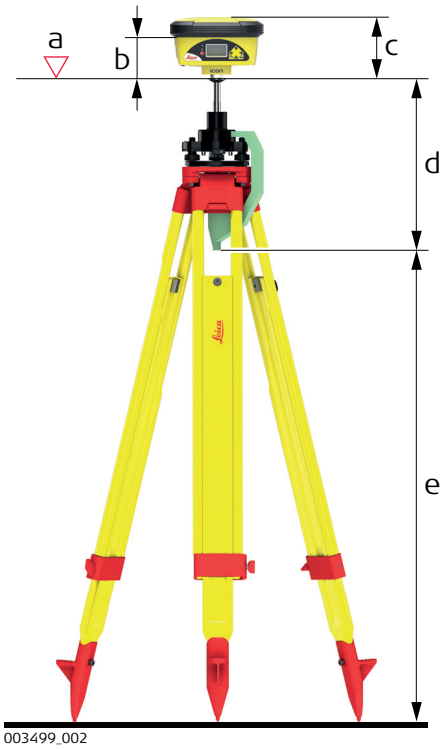
No vertical offset.

Determining the antenna height with the GRT146 carrier step-by-step

Step	Description
1.	Measure a height from the pillar benchmark to a surface on the carrier. 
2.	Use the appropriate measurement from the diagram above. Determine the height difference between the measured surface on the carrier and where the MRP of the antenna sits on the carrier.
3.	The vertical height reading = adding the values in step 1. and step 2.

Measuring the antenna height - tripod setup

Setup Type	Antenna type	The required measurement
Tripod	iCON gps 60 SmartAntenna	the vertical height reading from the height hook.



a) Mechanical reference plane MRP
b) Vertical phase centre offset for L1
c) Vertical phase centre offset for L2
d) Vertical offset
e) **Vertical Height Reading**

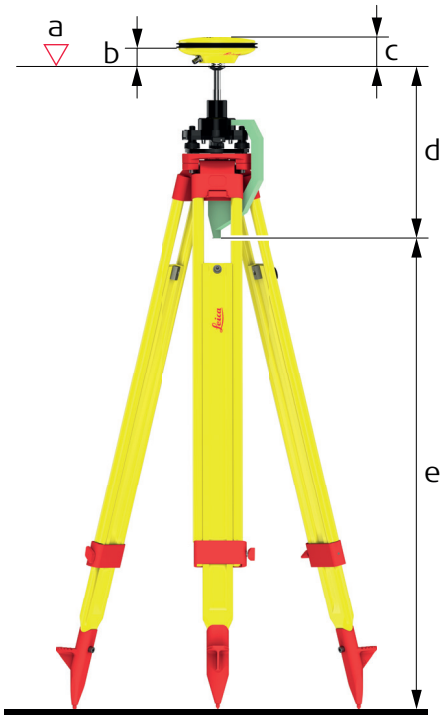
Vertical offset = 0.36

Determining the antenna height with the height hook step-by-step

Step	Description
1.	The vertical height reading = vertical height reading from the height hook. • The vertical height reading is the height difference between the ground mark and the bottom end of the height hook. • The vertical offset of 0.36 m is automatically stored in the antenna setup record for a tripod setup and will automatically be taken into account. It does not need to be entered.

Measuring the antenna height - tripod setup

Setup Type	Antenna type	The required measurement
Tripod	CGA60	the vertical height reading from the height hook.



a) Mechanical reference plane MRP
b) Vertical phase centre offset for L1
c) Vertical phase centre offset for L2
d) Vertical offset
e) **Vertical Height Reading**

Vertical offset = 0.36

Determining the antenna height with the height hook step-by-step

Step	Description
1.	The vertical height reading = vertical height reading from the height hook. • The vertical height reading is the height difference between the ground mark and the bottom end of the height hook. • The vertical offset of 0.36 m is automatically stored in the antenna setup record for a tripod setup and will automatically be taken into account. It does not need to be entered.

3.9.5 Measuring the Antenna Height for a Pole Setup

Measuring the antenna height - pole setup

Setup Type	Antenna type	The required measurement
Pole	iCON gps 60 SmartAntenna	vertical height reading of the pole.

4 Setups with Accessories

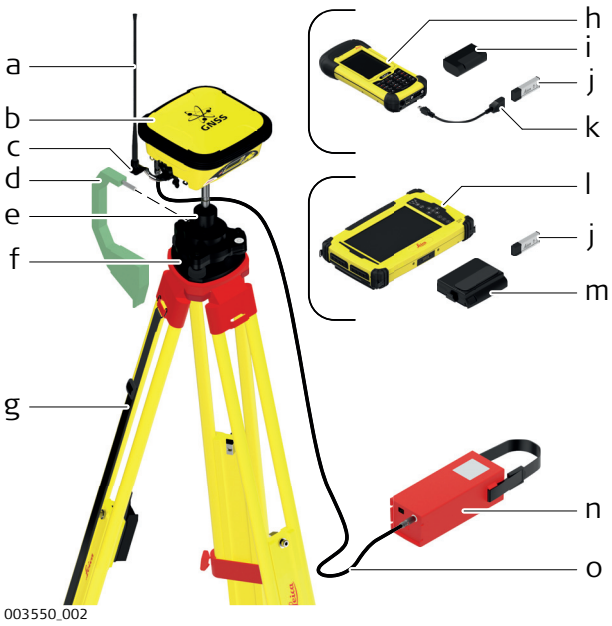
In the following chapters example configurations are shown, covering the most common use cases.
Further configurations are possible. Please contact the local selling unit or dealer for information regarding special use cases.

iCON gps 60 Smart-Antenna general description

The iCON gps 60 SmartAntenna is equipped with an integrated HSDPA modem for network access, for example Ntrip. To work with a local base, a radio module can be installed manually if required.

4.1 Real-Time Base Setup

Real-time reference setup with internal modem



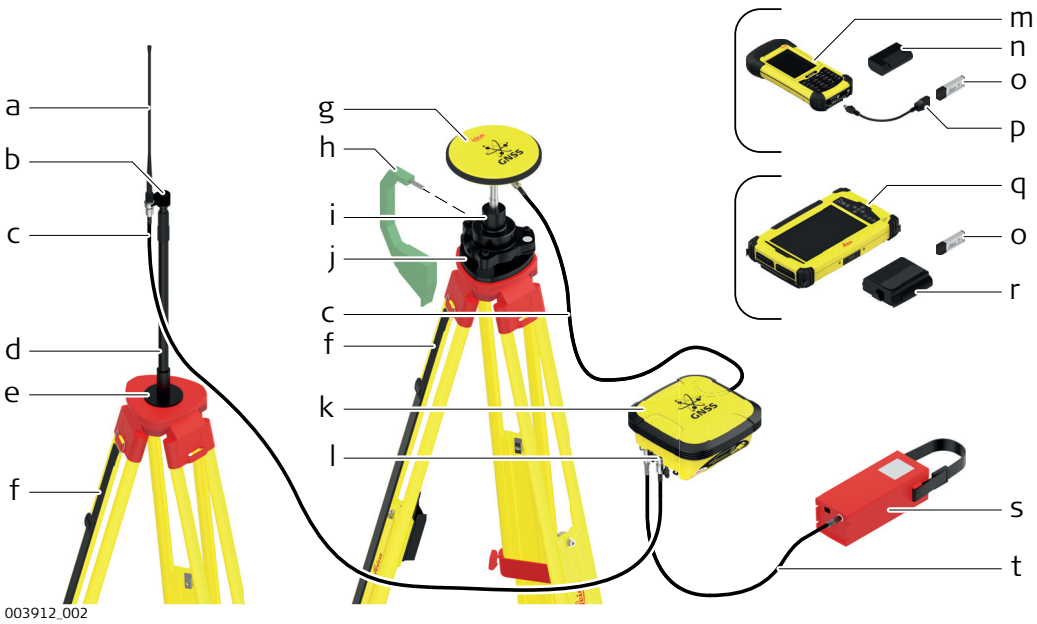
a) Radio antenna
b) iCON gps 60 SmartAntenna
c) GAD108 Antenna arm
d) GSZ4-1 Height hook
e) GRT146 Carrier
f) Tribrach
g) Tripod
h) CC50/CC55 Field Controller
i) Battery for CC50/CC55 Field Controller
j) USB Memory device
k) Mini-USB to USB cable
l) CC60/CC61/CC65/CC66 Field Controller
m) Battery for CC60/CC61/CC65/CC66 Field Controller
n) GEB171 external battery
o) GEV219 power cable

Real-time reference setup step-by-step

Step	Description
1.	**Setting Up the Equipment**
	• Set up the tripod, mount and level the tribrach onto the tripod.
	• Check that the tribrach is correctly centred over the marker.
	• Place and lock the carrier into the tribrach.
	• Screw the iCON gps 60 SmartAntenna onto the carrier.
	• Check that the tribrach is still correctly positioned and levelled.
	• Hang the external battery onto a tripod leg.
	• Take the GEV219.
	• Attach the 8 pin plug connector to the iCON gps 60 SmartAntenna.
	• Attach the 5 pin plug connector to the external battery.
	• Insert the battery into the field controller.
	• Turn on the antenna and the controller.
2.	**Perform a Base Station setup on the iCON gps 60** SmartAntenna **or run the Reference Setup application of the iCON site software**
	• Refer to "6.1 Base Setup" respectively the iCON site software manual for further information.

4.2 Local Base Station Setup with External GNSS Antenna

Local Base Station setup with external GNSS antenna



a) Radio antenna
b) GAD34 arm, 3 cm
c) GEV120 antenna cable, 2.8 m, 2 x
d) GAD32 telescopic rod
e) GHT36 base for telescopic rod
f) Tripod, 2 x
g) CGA60 Robust triple frequency GNSS antenna
h) GSZ4-1 Height hook
i) GRT146 Carrier
j) Tribrach
k) iCON gps 60 SmartAntenna
l) GAD109 QN/TNC adapter
m) CC50/CC55 Field Controller
n) Battery for CC50/CC55 Field Controller
o) USB Memory device
p) Mini-USB to USB cable
q) CC60/CC61/CC65/CC66 Field Controller
r) Battery for CC60/CC61/CC65/CC66 Field Controller
s) GEB171 external battery
t) GEV219 power cable

Local Base Station setup with external GNSS antenna step-by-step

Step	Description
1.	**Setting Up the CGA60 and radio antenna:**
	• Set up both tripods.
	• Mount and level the tribrach onto the tripod for the CGA60.
	• Check that the tribrach is correctly centred over the marker.
	• Place and lock the carrier into the tribrach.
	• Screw the CGA60 antenna onto the carrier.
	• Check that the tribrach is still correctly positioned and levelled.
	• Mount the GHT36 on the 2nd tripod. Attach the telescopic rod and the GAD34 arm.
	• Screw the radio antenna onto the GAD34 arm.
2.	**Setting Up the iCON gps 60 SmartAntenna:**
	• Place the iCON gps 60 SmartAntenna e.g. in a container.
	• Attach the QN/TNC adapter to the QN port.
	• Connect the TNC cable to the QN/TNC adapter of the SmartAntenna and the GAD34 at the radio antenna.

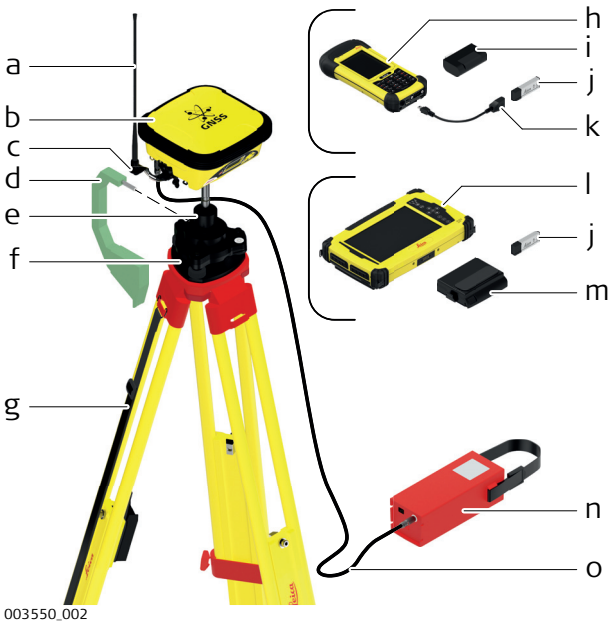
Step	Description
	• Connect a second TNC cable to the SmartAntenna and the CGA60 antenna.

	• Connect the iCON gps 60 SmartAntenna via the 8-pin socket to an external power source.
	  • Use the GEV219 cable to connect the external battery GEB171 using the 5-pin socket.
	OR
	  • Use the GEV71 cable to connect i.e. a car battery with the free wire ends.

	• Insert the battery into the field controller.
	• Turn on the antenna and the controller.
3.	**Perform a Base Station setup on the iCON gps 60** SmartAntenna **or run the Reference Setup application of the iCON site software**
	• Refer to "6.1 Base Setup" respectively the iCON site software manual for further information.

☞ Connecting the GEV71 cable to an external power source (i.e. car battery) needs expert knowledge.

Real-time reference setup for raw data logging

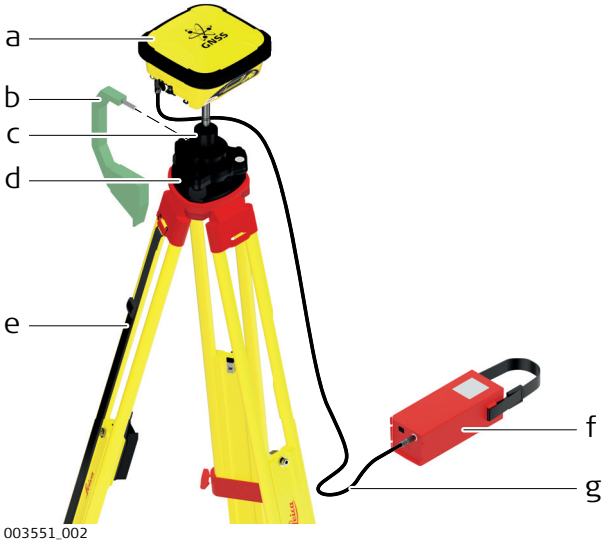


a) Radio antenna
b) iCON gps 60 SmartAntenna
c) GAD108 Antenna arm
d) GSZ4-1 Height hook
e) GRT146 Carrier
f) Tribrach
g) Tripod
h) CC50/CC55 Field Controller
i) Battery for CC50/CC55 Field Controller
j) USB Memory device
k) Mini-USB to USB cable
l) CC60/CC61/CC65/CC66 Field Controller
m) Battery for CC60/CC61/CC65/CC66 Field Controller
n) GEB171 external battery
o) GEV219 power cable

Real-time reference setup for raw data logging step-by-step

Step	Description
1.	**Setting Up the Equipment**
	• Set up the tripod, mount and level the tribrach onto the tripod.
	• Check that the tribrach is correctly centred over the marker.
	• Place and lock the carrier into the tribrach.
	• Screw the iCON gps 60 SmartAntenna onto the carrier.
	• Check that the tribrach is still correctly positioned and levelled.
	• Hang the external batteries onto the tripod legs.
	• Take the GEV219 cable.
	• Attach the connector with the 8 pin plug to the iCON gps 60 SmartAntenna.
	• Attach the connector with the 5 pin plug to the external battery.
	• Turn on the antenna and the controller.
2.	**Configuring the Raw Data Logging**
	• Refer to "6.4 Raw Data Logging".
3.	**Perform a Base Station setup on the iCON gps 60** SmartAntenna **or run the Reference Setup application of the iCON site software**
	• Refer to "6.1 Base Setup" respectively the iCON site software manual for further information.

Raw data logging setup for post-processing



a) iCON gps 60 SmartAntenna
b) GSZ4-1 Height hook
c) GRT146 Carrier
d) Tribrach
e) Tripod
f) GEB171 external battery
g) GEV219 power cable

Raw data logging setup step-by-step

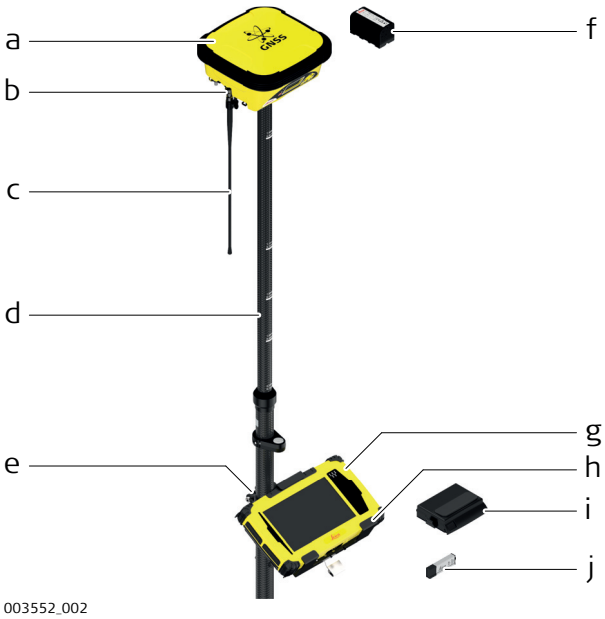
Step	Description
1.	**Setting Up the Equipment**
	• Set up the tripod, mount and level the tribrach onto the tripod.
	• Check that the tribrach is correctly centred over the marker.
	• Place and lock the carrier into the tribrach.
	• Screw the iCON gps 60 SmartAntenna onto the carrier.
	• Check that the tribrach is still correctly positioned and levelled.
	If available:
	• Hang the external battery onto a tripod leg.
	• Take the GEV219.
	• Attach the connectors with the 8 pin plug to the iCON gps 60 SmartAntenna.
	• Attach the connector with the 5 pin plug to the external battery.
	• Turn on the antenna.
	Else:
	• Use internal battery of the antenna without battery cabling.
2.	**Configuring the Raw Data Logging**
	• Refer to "6.4 Raw Data Logging".

4.5 Real-Time Rover Setup

Use

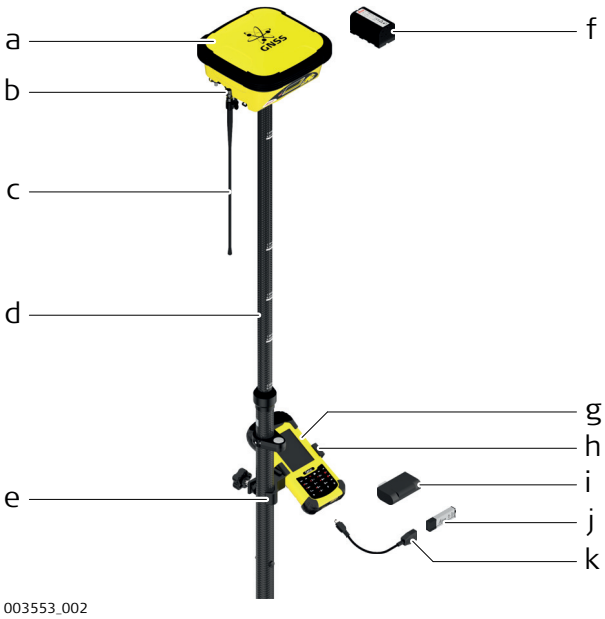
The equipment setup is used for real-time rover with extended periods of use in the field.

Real-time rover setup with iCON CC60/CC61/CC65/ CC66



a) iCON gps 60 SmartAntenna
b) GAD109 QN/TNC adapter
c) Radio antenna
d) Pole
e) Pole clamp
f) GEB221/GEB222 battery
g) CC60/CC61/CC65/CC66 Field Controller
h) Holder for Field Controller
i) Battery for Field Controller
j) USB Memory device

Real-time rover setup with CC50/CC55



a) iCON gps 60 SmartAntenna
b) GAD109 QN/TNC adapter
c) Radio antenna
d) Pole
e) Pole clamp
f) GEB221/GEB222 battery
g) CC50/CC55 Field Controller
h) Holder for Field Controller
i) Battery for Field Controller
j) USB Memory device
k) Mini-USB to USB cable

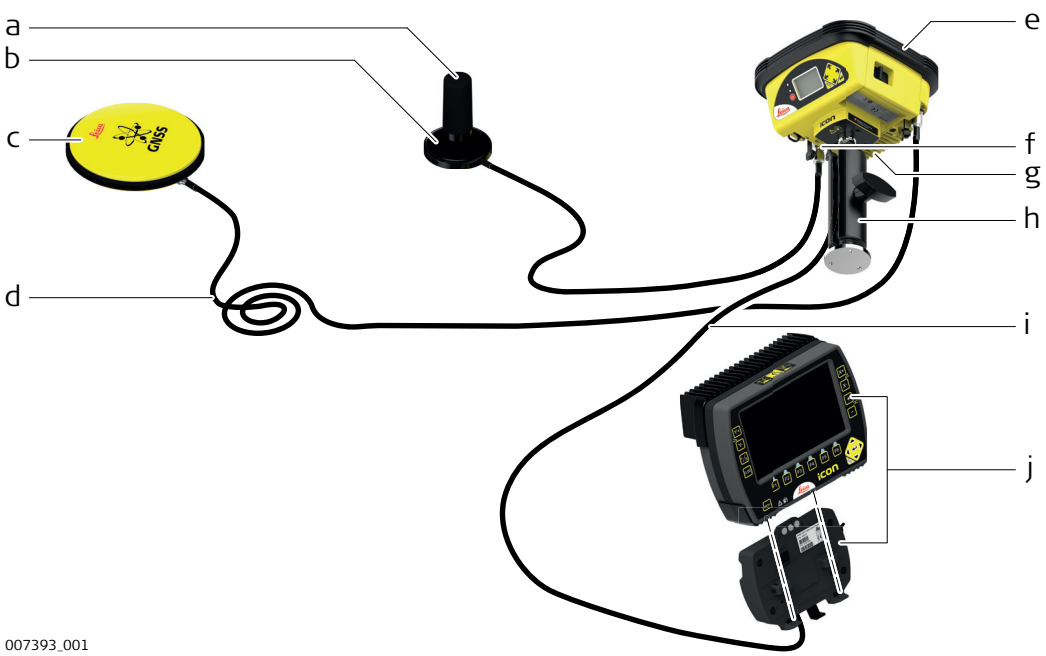
Real-time rover setup step-by-step

Step	Description
1.	**Setting Up the Equipment**
	• Insert the battery into the iCON gps 60 SmartAntenna.
	• Screw iCON gps 60 SmartAntenna onto the top of the telescopic pole.
	• Ensure that the compression lock is not clamped.

Step	Description
	• Extend the telescopic pole and ensure that the snap-lock clicks into its position. The snap-lock ensures that there is no slipping of the telescopic pole.
	• Clamp the compression lock. The compression lock maintains straightness.
	• Fix the holder to the clamp with the tightening screw. Before tightening, ensure that the holder is at a comfortable working height and angle. This can be achieved by sliding the clamp along the pole and rotating the holder about the clamp. Tighten the tightening screw.
	• Insert the battery into the field controller.
	• Clip the field controller onto the holder and lock into position.
	• Turn on the antenna and the controller.
2.	**Run the data collection or stake-out application of the iCON Site software**
	• Refer to the iCON site software manual for further information.

4.6 Setup for Machine Use

Setup for Machine use



007393_001

a) Radio antenna CA12
b) CA11 Magnetic radio antenna mount
c) CGA60 Robust triple frequency GNSS antenna
d) CA16 Antenna cable, 10 m
e) iCON gps 60 SmartAntenna
f) GAD109 QN/TNC adapter
g) Internal modem
h) Machine Bracket CMB3
i) Cable for cradle 8Pin Lemo/open end, 7 m
j) Machine PC

☞ All necessary installation works must be done by a dedicated installation specialist. Please contact the local selling unit or dealer for further information.

Bluetooth connection setup

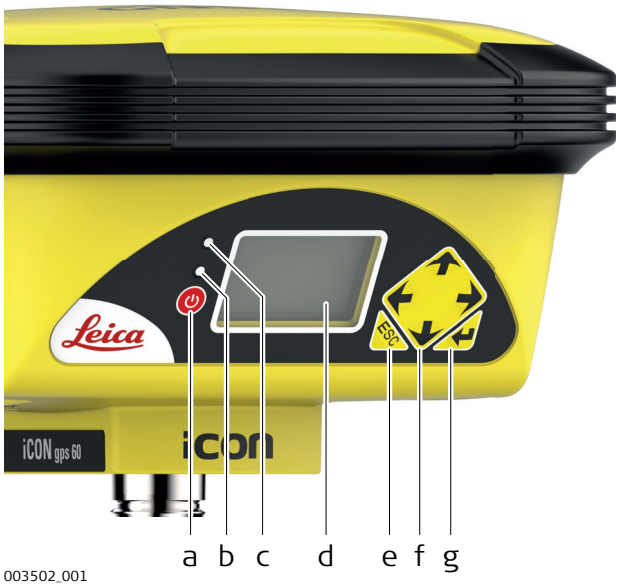
Activate the internal Bluetooth module of the iCON gps 60 SmartAntenna. Refer to "Bluetooth Menu".

☞ Follow the instructions of the controller user manual about how to establish a Bluetooth connection.

5 iCON gps 60 SmartAntenna User Interface

5.1 User Interface Description

User Interface overview



a) ON/OFF key
b) Power and status LED
c) Ambient light sensor
d) Display
e) ESC key
f) Navigation keys
g) ENTER key

User Interface elements

The instrument can be controlled via the user interface elements.

Element		Function
Navigation keys 		4-way navigation in the menus via left, right, up and down key.
Enter key 		• To activate editing. • To accept changes. • To enter a menu or submenu.
ESC key 		• To cancel operations. • To leave a menu or submenu.
ON/OFF key 		Gives access to startup and shutdown: press for three seconds.
Display		Displays status information and software functions.
Ambient light sensor		Energy saving ambient light sensor. ☞ When the display **Backlight** is set to **Auto**, the Backlight intensity is automatically adjusted on the ambient light sensor input.
Power LED	off	Instrument is switched off.
	continuously green	• Normal operation mode. • No errors. • Battery level **above 20%**.
	continuously red	• During start-up of the instrument. • For various errors occuring. The current status information is shown on the display.

☞ Use the ↑ and ↓ navigation keys to select a menu icon and to navigate within submenus.

☞ Use the key to enter a submenu and confirm settings.

☞ Use the key to discard settings, cancel operations and to go back one menu level.

5.2 Main Menu

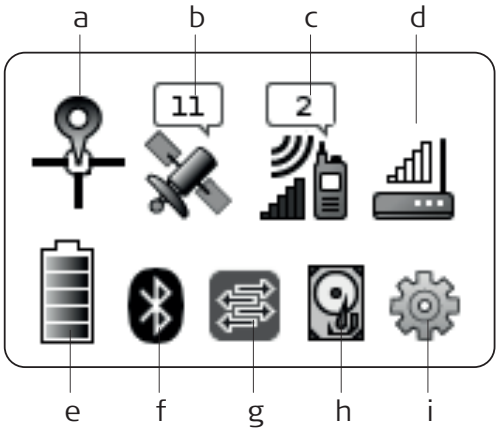
Description

The Main Menu is the first screen displayed when the instrument is switched on.

Main menu content

The Main Menu features a matrix set of menu icons.

☞ The appearance of the menu icons depend upon the current instrument status and setup.



a) Position icon
b) Satellite icon
c) Radio icon
d) Modem icon
e) Battery/Power icon
f) Bluetooth icon
g) iCON telematics/Port Summary icon
h) Memory and logging icon
i) Settings icon

Additional icon information

The menu icons on the display provide additional information related to basic instrument status.

Icon		Description
Position		Instrument has not obtained a position.
		• Navigated position has been obtained. • Error ≤ 10 m.
		• Float position has been obtained. • Error ≤ 0.5 m.
		• xRTK position has been obtained. • Error < 0.05 to 0.10 m.
		• High accuracy position has been obtained. • Error ≤ 0.05 m.
		iCON gps 60 SmartAntenna is operating as a **base**.
		BasePilot setup in progress.
		BasePilot setup failed.

Icon		Description
Satellite		No satellites tracked.
		Number of tracked satellites.

Icon		Description
Radio		Radio not in use.
		• Radio set to receive correction data in **rover** mode. • Active radio channel is displayed. • Waves flash when correction data is received.
		• Radio set to transmit correction data in **base** mode. • Active radio channel is displayed. • Waves flash when correction data is transmitted.
		Radio error.

Icon		Description
Modem		Modem not in use.
		Modem connected to a cell phone network.
		• Modem set to receive correction data in **rover** mode. • Waves flash when correction data is received.
		• Modem set to transmit correction data in **base** mode. • Waves flash when correction data is transmitted.
		Modem error.

Icon		Description
Bluetooth		Bluetooth OFF.
		Bluetooth ON.
		Bluetooth connection active.

Icon		Description
Battery / Power		Internal battery in use. Bars indicate the battery power level.
		Internal battery low.
		• External power is used. Internal battery **is installed**.
		• External power is used. Internal battery **is not installed**.
		External power is used, low voltage warning.

Icon		Description
iCON Telematics		**iCON Telematics** is not configured or is configured but idle.
		New firmware is available.
		View function enabled.
		Flashing arrows in the icon: Track function enabled.
		**iCON Telematics** error.
Port Summary		**Port Summary**: view the current status for the NMEA output and Remote (MPI).

Icon		Description
Memory and logging		Memory icon (internal memory).
		USB Memory device inserted.
		Raw data logging ongoing.
		Memory error (internal memory is full, needs attention).

Icon		Description
Settings		Settings icon.

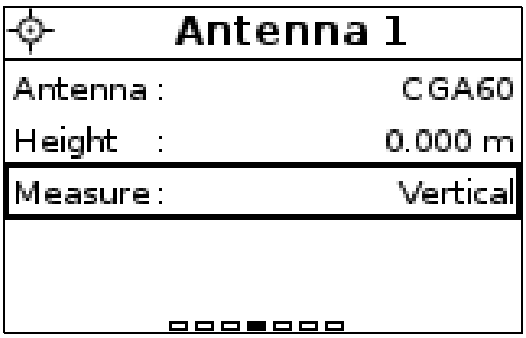
5.3 Submenus

5.3.1 Navigation in Submenus

How to navigate in submenus

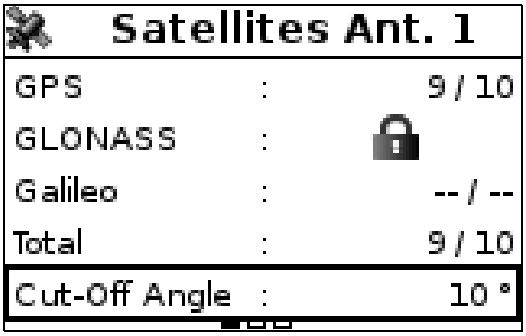
- Use the ↑ and ↓ navigation keys to select a submenu entry.
- To enter a submenu, highlight the menu entry of interest and press ↵.
- Use the ← and → navigation keys to navigate through a submenu with multiple pages.

Example of a submenu



Small boxes at the bottom of a submenu page indicate the number of pages within the submenu, while a solid black box indicates the current page.

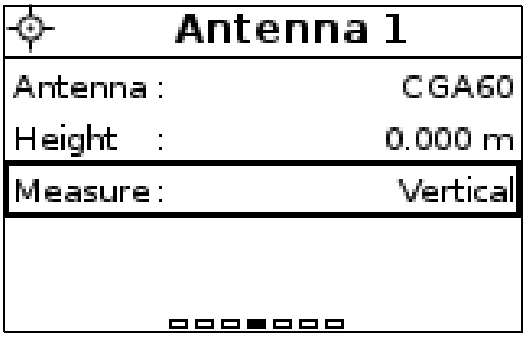
Locked Submenus



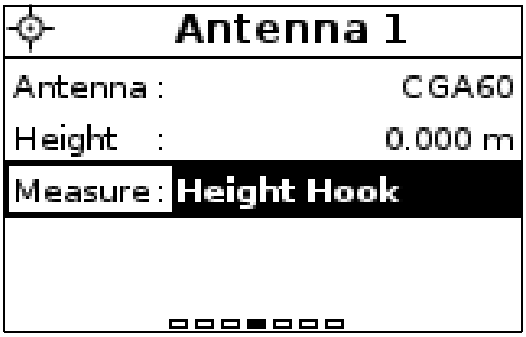
Features that are not active due to a missing licence are marked with a **lock** symbol ( ).

5.3.2 How to Change Settings and Edit Values

How to change settings

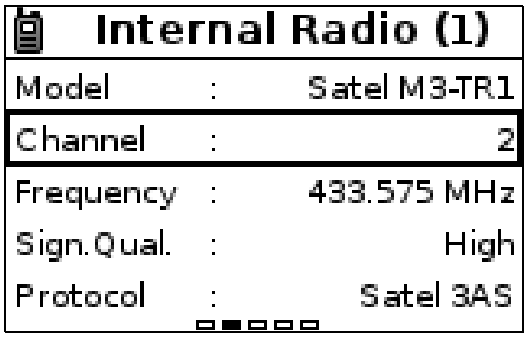


- Enter the desired submenu as described before, for example **Antenna 1** settings.
- The first editable value is automatically selected, indicated by a frame around the entry.
- Use the ↑ and ↓ navigation keys, to select the desired option, for example **Measure**.

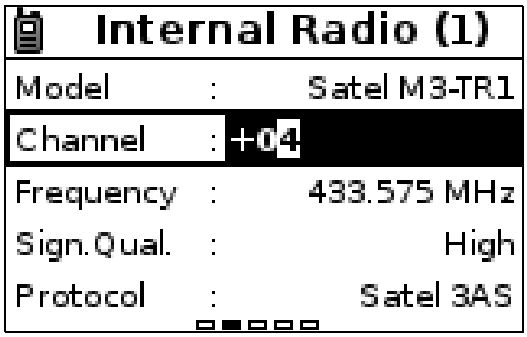


- Press ↵ to enter the list of available options.
- Use the ← and → navigation keys to scroll through the list of options.
- Press ↵ to confirm the selection, or
- press ESC to discard the setting and cancel the operation.

Select and edit values



- Enter the desired submenu as described before, for example **Internal Radio (1)** settings.
- Use the ↑ and ↓ navigation keys, to select the desired option, for example **Channel**.

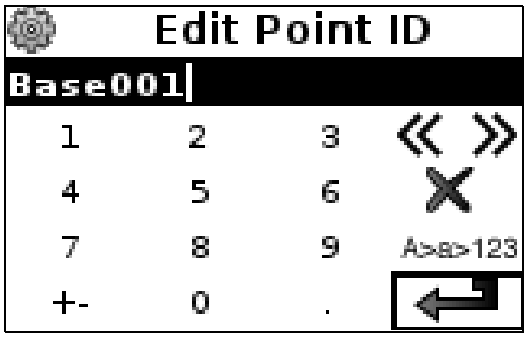


- Press ↵ to enter the input field.
- Use the ↑ and ↓ navigation keys, to change the value of a digit.
- Use the ← and → navigation keys to change to another digit.
- Press ↵ to confirm the setting, or
- press ESC to discard the setting and cancel the operation.

Enter numbers or text

The user interface is equipped with a virtual keyboard for alphanumerical and numerical input.

☞ The virtual keyboard works similar to a mobile phone keyboard. Press ↵ repeatedly to toggle between the different characters.



First select a submenu item, as shown in the example.

- Press ↵ to edit a number/text field.
- Use the navigation keys to select a key on the virtual keyboard.
- Press ↵ (if necessary repeatedly) to select and enter a character or number.
- Highlight ↵ and press ↵ to save the changes.

Special keys	Function
A>a>123	Switches between upper/lower case characters and the numerical keyboard.
« »	Moves the position of the cursor.
✕	Deletes the character left of the cursor (backspace functionality).
↵	Stores the current content of the description field and ends input mode.

Position Menu

Informs about:
- **Position Quality**:
  - **Position Quality**
  - **Height Quality**
  - **GDOP**: Geometric Dilution Of Precision. The smaller the number, the higher the possible precision.
  - **Solution**: **Navigated**, **Float**, **Fixed (XRTK)** or **Fixed**
- **Position Antenna**:
  - The coordinate system used: **WGS84**, **Via Network** or any loaded coordinate system files.
  - Position Coordinates
  - Position Height
- **Antenna 1**:
  - The active GNSS antenna
  - Height of the active antenna
  - Measurement mode of antenna height: **Vertical** or **Height Hook**
- **RTK Mode**:
  - The active **RTK Mode**
  - BasePilot: Used or Not Used
- Current **Date & Time**

Configurable values (if external antenna is connected):
- Antenna type
- Antenna height
- Measurement mode of Antenna height

Satellite Menu

Informs about:
- **Satellites Antenna1**:
  - The number of tracked satellites and available satellites, if no position is given (no base correction data received).
  - The number of used satellites and available satellites, when position is available (with base correction data).
  - **Cut-Off Angle**: below this defined angle satellites will not be taken into account for calculations.
- **Reference Satellites**:
  - The number of reference satellites, in rover mode only.

Configurable value:
- **Cut-Off Angle**

Radio Menu

Informs about:
- Radio status information, including managing internal power supply for the radio
- Connection details of the internal and / or external radio
- Base station information

Configurable values:
- Radio channel
- Internal power supply Yes/No, Radio On/Off
- Protocol (for some radio types only)

☞ For an internal Satelline radio or an external GFU27 radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed.

Modem Menu

Informs about:
- **Internal Modem**:
  - Modem type and connection details
  - Managing internal power supply for the modem
  - RTK status
  - Base Station information

Configurable values:
- Internal power supply for the modem Yes/No
- Modem connect/disconnect
- Selected mobile internet service type

Power Menu

Informs about:
- Battery level of internal and / or external battery

Configurable values:
- None

Bluetooth Menu

Informs about:
- Bluetooth connection details and status

Configurable value:
- Activate/deactivate Bluetooth

iCON Telematics and Port Summary Menu

Informs about:
- The status of **iCON Telematics** and its functions View, Track and Sync
- Enable or disable the **Share screen** function, to allow a remote user to view the iCON gps 60 SmartAntenna screen
- The different ports and their usage/status

Configurable values:
- Activate/deactivate **Share screen**

Storage Menu

Informs about:
- **Internal Memory**:
  - Free/Used/Total Memory
  - Raw data logging active/inactive
- **USB Storage**:
  - Free/Used/Total Memory, when a USB memory device is inserted

Configurable values:
- None

Settings Menu

Contains following submenus:
- **Tools**
- **System Information**
- **System Configuration**
- **Service**
- **Copyrights**

Settings Menu: Tools

Functions	Description
Base Setup	Execute a Base Station setup. Refer to "6.1 Base Setup" for further information.
Rover Setup	Execute a Rover setup. Refer to "6.2 Rover Setup" for further information.
NMEA Output	Attend the NMEA Output settings. Refer to "6.3 ORP and NMEA Output" for further information. ☞ The appropriate license must be installed to access the NMEA Output wizard.
Raw Data Logging	• Setup/Start Raw Data Logging. Refer to "6.4 Raw Data Logging" for further information. • View the Log file list. • Export Log files to a connected USB memory device. • Delete all Log files.
iCON Telematics	• View the current **iCON Telematics Status**. • **iCON Sync Download**: download data from the iCON telematics web page. • **iCON Sync Upload**: upload data to the iCON telematics web page. • **iCON Telematics Firmware**: search for and execute available instrument firmware updates from the iCON telematics web page. • Perform a **iCON Telematics Setup**. ☞ Refer to "6.5 iCON Telematics" for further information on the different functions.
Import / Export / Delete	• Import data from a connected USB memory device. • Export data to a connected USB memory device. • Delete data stored on the instrument. Available options to delete: **Base point list**, **Antenna list**, **Welcome screen**, **Support logs**, and **Coordinate systems**.
Licenses	• **View** active **licenses**. • **Upload license file** from a connected USB memory device. • **Enter license key**. • **Delete all licenses** stored on the instrument.

Settings Menu: System Information

Functions	Description
System Information	• **Instrument Type** and Serial Number. • Active firmware version. • Information about the Measurement Engine, the Internal Radio, and the Internal GSM-Modem.

Settings Menu: System Configuration

Functions	Description
Upload Firmware	Firmware file must be placed in a folder called **system** on a USB memory device.
GNSS Settings	• Configure GNSS tracking settings GPS L2C, GPS, GLONASS & Galileo. • To activate or deactivate xRTK. ☞ xRTK is a slightly less accurate RTK position type, typically 5 to 10 cm, automatically providing more availability for phase fixed positions with a reliability of 99%. Recommended when working in heavy canopy environments. For NMEA messages, positions measured with the xRTK mode are flagged as fixed.
Coordinate systems	To set the Coordinate system used. Choose from **WGS84**, **Via Network** or any loaded coordinate system files.
Reset Options	Reset options are available for the Memory, the External Port Configurations, the Instrument, and Almanac. ☞ The Almanac is a set of data that every GNSS satellite transmits, and it includes information about the state of the entire satellite constellation, and coarse data on every satellite's orbit. When the iCON gps 60 instrument has current almanac data in memory, it can acquire satellite signals and determine initial position more quickly.
Choose Language	Change system language.
Screen Settings	• Set display **Backlight** options: – **Auto**: Ambient light sensor is used to automatically adjust screen backlight for best display. – **Full**: Screen backlight is set to full brightness. – **Off**: Backlight is turned off. • Set display **Power Saver** options: – **Off**: Screen backlight will not turn off. – **5 s**, **30 s**, **1 min.**, ...: Screen backlight remains on for the time period set following the last key press.
Startup & Shutdown	• When **Start on Pulse to Port** is set to **On**: The instrument will automatically start up after receiving a pulse signal on port **P1**. • When **Start on Power to Port** is set to **On**: The instrument will automatically start up when power is available on port **P1**.
Date & Time	Define **Time Zone** and **D**aylight **S**aving **T**ime.
Units & Formats	• Set the Unit used for **Distance**. • Define **Date** and **Time** format.
Upload ME Firmware	Single ME files selectable to upgrade the ME (Measurement Engine).
Ethernet Settings	• Select the Internet device: **Modem** or **Ethernet**. • Switch **Ethernet** on/off.

Settings Menu: Service

Functions	Description
Service	Password protected - for Service & Support staff only.

Functions	Description
Copyrights	Includes Open Source Software License information.

This software contains copyright-protected software that is licensed under various open source licenses.

- Press **Settings** › **Copyrights** to view the copyright information and a link to download the source code and license text.

And/Or

- The according copyright statements and license texts are part of the documentation delivered with this product.

If foreseen in the corresponding open source licence, you may obtain the source code, license texts and other related data on the open source centre website of Leica Geosystems, http://opensource.leica-geosystems.com.

6 Software Tools

6.1 Base Setup

6.1.1 Base Setup Description

Setup iCON gps 60 SmartAntenna as Base Station

The iCON gps 60 SmartAntenna can be setup and used as Base Station. Measured Base Points can be recorded in the instrument and a Base Point list can be imported and used for future Base Setups.

There are different options to setup the iCON gps 60 SmartAntenna as Base Station:

- **Manual Base Setup**:
  - When no Base Setup has been performed and recorded before to the iCON gps 60 SmartAntenna and no Base Point List has been imported, it is necessary to perform a manual Base Setup.
  - Manual Base Setup is always possible, also with a imported Base Point List or a previously recorded Base Setup.
- **Base Setup using BasePilot**:
  - iCON gps 60 SmartAntenna features a tool for automatic Base Setup called BasePilot.
  - BasePilot is enabled automatically when the iCON gps 60 SmartAntenna is powered up on an existing base point. BasePilot recognises that the instrument is in base mode, is over a known point and automatically loads the previously stored base configuration.

Using the Base Point List

The Base Point List comprises a list of known base points with all corresponding base system configuration data. It is used with the BasePilot functionality for fast automatic base configuration.

☞ The Base Point List can be exported, imported and deleted via the **Import / Export / Delete** submenu. Refer to "6.6 Import, Export, or Delete Data" for further information.

No stored positions nearby

If no base point in the Base Point List is close to the current instrument position an information message shows up:

There are no existing Base Points nearby!

If this information appears:

- Confirm the message by pressing  on **Continue**.
- Use the **Edit** or **Get here** function to set up the base station.

6.1.2 Manual Base Setup

Base Setup

The instrument can be manually set up as a stand-alone base station without a controller. This can be done in three different ways using the Base Setup wizard:

- **Get here**:
  Instrument determines position and **uses current position as a new base point**.
- **Edit**:
  Manual input of coordinates to **generate a new base point**.
- **Find nearest**:
  Searches through the **Base Point List for a known base point** within a radius of 20 m of the current instrument position.

☞ The following step-by-step descriptions explain the different options in detail.

Get here step-by-step

The **Get here** function determines the current coordinates of the instrument and uses this position as the base point.

Step	Description
1.	According to your needs, setup the hardware needed at the desired base point position. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	Access the wizard via **Settings** › **Tools** › **Base Setup**.
3.	In the **Position** screen highlight **Modify** and press .
4.	Select **Get here** and press to confirm.
5.	In the **Antenna** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Select **Continue** and press to confirm. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
6.	When ready to determine the current position, select **Continue** and press to confirm.
7.	The instrument measures the current position. Subsequently it searches the Base Point List for stored base points in the vicinity.
8.	If there is already a point within a 40 m radius of the measured point stored in the instrument a message is displayed: • Select **Overwrite** to use the newly measured position, or • select **Use existing** to use the known point. – In case the existing point has been chosen, a second warning message is displayed where you can choose between **Saved setup** to use the saved Base point setup, including Antenna and Communication settings, or **Current** to use the currently loaded configuration. If no point is found within a 40 m radius of the measured position the instrument returns to the **Position** screen.
9.	Back in the **Position** screen select **Modify** and **Edit** and press to confirm.
10.	In the **Edit Position** screen: • Select **Pt. ID** and press to confirm. • Enter a Point ID and press to confirm. • If needed, position and height values can be changed. • When finished, select **Continue** and press to confirm. New Point ID, position and height values are stored and instrument returns to the **Position** screen.
11.	Use the ➔ navigation key to proceed to the **Communication** setup screen, for example to establish a connection via radio. ☞ It is possible to use three communication devices running in parallel. • To configure the settings for **Internal Radio** continue with 12. • To configure the settings for **External Radio P1** continue with 13. • To configure the settings for **Internal Modem** continue with 14. • Otherwise continue with 30.

Step	Description
12.	For the **Internal Radio** select **On**, **Off** or **Edit** and press to confirm. When **Edit** was selected: • In the **Internal Radio** screen select the **Channel** and the **Protocol**. Please note that **Protocol** is only available for the internal Satel radio TA13. ☞ For an internal Satelline radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed. • In the **RTK Settings** screen select the **Corr.Format** (Correction Format) and define the use for **Time Slicing**. • When finished, confirm in the **Save Settings** screen.
13.	For the **External Radio P1** select **On**, **Off** or **Edit** and press to confirm. When **Edit** was selected: • In the **External Radio (1)** screen select the **Model**: – For generic radio setting (**Generic RS232**), where no device is auto-detected, select **Baud rate** and **Flow contr.**. – For external radios which are automatically detected, the **Model** is also selected automatically. In the **External Radio (2)** screen select the **Channel** and the **Protocol**. – For external radios which are not automatically detected, select the **Model** in the **External Radio (1)** screen and in the **External Radio (2)** screen select the **Channel** and the **Protocol**. ☞ For an external GFU27 radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed. • In the **RTK Settings** screen select the **Corr.Format** (Correction Format) and define the use for **Time Slicing**. • When finished, confirm in the **Save Settings** screen.
14.	For the **Internal Modem** select **On**, **Off** or **Edit** and press to confirm. When **Edit** was selected: • For the **Internal Modem** select **NTRIP Source**, **NTRIP Base**, or **DialUp** as **Mode**. • To configure the settings for **NTRIP Source** continue with 15. • To configure the settings for **NTRIP Base** continue with 20. • To configure the settings for **DialUp** continue with 27.
15.	In the **Int. Modem** screen select **NTRIP Source** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
16.	Use the ➔ navigation key to proceed to the next step.
17.	In the **Caster Settings** screen select the **Mode** and enter **Address**, **Port**, **Mnt.Pt.** (mount point) and **Password**.
18.	Use the ➔ navigation key to proceed to the next step.
19.	In the **Save Settings** screen select the **Correct. format** (Correction Format). Use the ➔ navigation key to save the settings and enable the device.
20.	In the **Int. Modem** screen select **NTRIP Base** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
21.	Use the ➔ navigation key to proceed to the next step.

Step	Description
22.	• In the **DynDNS Settings** (for Dynamic Domain Name System) screen select the **Provider** and enter **Host**, **Username** and **Password**. • When using a SIM card with a fixed IP set **DynDNS** to **Off**. ☞ The fixed IP functionality for a SIM card must explicitly be ordered at the network provider.
23.	Use the ➔ navigation key to proceed to the next step.
24.	In the **NTRIP Settings** screen enter **Port** number, **Username** and **Password**. ☞ The port number entered must be accessible from outside your local cell network.
25.	Use the ➔ navigation key to proceed to the next step.
26.	In the **Save Settings** screen select the **Correct. format** (Correction Format). Use the ➔ navigation key to save the settings and enable the device.
27.	In the **Int. Modem** screen select **DialUp** as **Mode**, and enter **PIN**.
28.	Use the ➔ navigation key to proceed to the next step.
29.	In the **Save Settings** screen select the **Correct. format** (Correction Format). Use the ➔ navigation key to save the settings and enable the device.
30.	Use the ➔ navigation key to proceed to the **Antenna** screen. The active **Antenna**, the **Height** of the active antenna, the **Measure** mode of antenna height and the **Ref.Stn.ID** (Reference Station Identification) might be changed again.
31.	Use the ➔ navigation key to proceed to the final step. • To save and apply the new Base Station settings select **Save** and press to confirm. • To discard the new Base Station settings select **Undo** and press . To actually discard the settings confirm the following Warning by pressing on **OK**.

Find nearest step-by-step

The **Find nearest** function searches through the Base Point List for base points in the vicinity.

Step	Description
1.	According your needs, setup the hardware needed at the desired base point position. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	Access the wizard via **Settings** › **Tools** › **Base Setup**.
3.	In the **Position** screen highlight **Modify** and press .
4.	Select **Find nearest** and press to confirm.
5.	The instrument searches for base points within a 20 m radius, which are stored in the Base Point List. The closest base point is selected automatically.
6.	If a Base Point is found within a 20 m radius of the current position: • Select **Saved setup** to use the saved Base point setup, including Antenna and Communication settings, or • select **Current** to use the currently used Base point setup. • Press to confirm the selection. If no Base Point is found within a 20 m radius an according information message is displayed. In this case the **Get here** or **Edit** function is needed to setup a base station.

Step	Description
7.	Back in the **Position** screen, re-check the selected base point information.
8.	Use the ➔ navigation key to proceed to the **Communication** setup screen, for example to establish a connection via radio. ☞ It is possible to use three communication devices running in parallel. • To configure the settings for **Internal Radio** continue with 9. • To configure the settings for **External Radio P1** continue with 10. • To configure the settings for **Internal Modem** continue with 11. • Otherwise continue with 27.
9.	For the **Internal Radio** select **On**, **Off** or **Edit** and press to confirm. When **Edit** was selected: • In the **Internal Radio** screen select the **Channel** and the **Protocol**. Please note that **Protocol** is only available for the internal Satel radio TA13. ☞ For an internal Satelline radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed. • In the **RTK Settings** screen select the **Correct. format** (Correction Format) and define the use for **Time Slicing**. • When finished, confirm in the **Save Settings** screen.
10.	For the **External Radio P1** select **On**, **Off** or **Edit** and press to confirm. When **Edit** was selected: • In the **External Radio (1)** screen select the **Model**: – For generic radio setting (**Generic RS232**), where no device is auto-detected, select **Baud rate** and **Flow contr.**. – For external radios which are automatically detected, the **Model** is also selected automatically. In the **External Radio (2)** screen select the **Channel** and the **Protocol**. – For external radios which are not automatically detected, select the **Model** in the **External Radio (1)** screen and in the **External Radio (2)** screen select the **Channel** and the **Protocol**. ☞ For an external GFU27 radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed. • In the **RTK Settings** screen select the **Correct. format** (Correction Format) and define the use for **Time Slicing**. • When finished, confirm in the **Save Settings** screen.
11.	For the **Internal Modem** select **On**, **Off** or **Edit** and press to confirm. When **Edit** was selected: • For the **Internal Modem** select **NTRIP Source**, **NTRIP Base**, or **DialUp** as **Mode**. • To configure the settings for **NTRIP Source** continue with 12. • To configure the settings for **NTRIP Base** continue with 17. • To configure the settings for **DialUp** continue with 24.
12.	In the **Int. Modem** screen select **NTRIP Source** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
13.	Use the ➔ navigation key to proceed to the next step.
14.	In the **Caster Settings** screen select the **Mode** and enter **Address**, **Port**, **Mnt.Pt.** (mount point) and **Password**.
15.	Use the ➔ navigation key to proceed to the next step.

Step	Description
16.	In the **Save Settings** screen select the **Correct. format** (Correction Format). Use the ➔ navigation key to save the settings and enable the device.
17.	In the **Int. Modem** screen select **NTRIP Base** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
18.	Use the ➔ navigation key to proceed to the next step.
19.	• In the **DynDNS Settings** (for Dynamic Domain Name System) screen select the **Provider** and enter **Host**, **Username** and **Password**. • When using a SIM card with a fixed IP set **DynDNS** to **Off**. ☞ The fixed IP functionality for a SIM card must explicitly be ordered at the network provider.
20.	Use the ➔ navigation key to proceed to the next step.
21.	In the **NTRIP Settings** screen enter **Port** number, **Username** and **Password**. ☞ The port number entered must be accessible from outside your local cell network.
22.	Use the ➔ navigation key to proceed to the next step.
23.	In the **Save Settings** screen select the **Correct. format** (Correction Format). Use the ➔ navigation key to save the settings and enable the device.
24.	In the **Int. Modem** screen select **DialUp** as **Mode**, and enter **PIN**.
25.	Use the ➔ navigation key to proceed to the next step.
26.	In the **Save Settings** screen select the **Correct. format** (Correction Format). Use the ➔ navigation key to save the settings and enable the device.
27.	Use the ➔ navigation key to proceed to the **Antenna 1** screen. The active **Antenna**, the **Height** of the active antenna, the **Measure** mode of antenna height and the **Ref.Stn.ID** (Reference Station Identification) might be changed. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
28.	Use the ➔ navigation key to proceed to the final step. • To save and apply the new Base Station settings select **Save** and press to confirm. • To discard the new Base Station settings select **Undo** and press . To actually discard the settings confirm the following Warning by pressing on **OK**.

Edit step-by-step

The **Edit** function can be used to enter a set of coordinates manually.

Step	Description
1.	According your needs, setup the hardware needed at the desired base point position. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	Access the wizard via **Settings** › **Tools** › **Base Setup**.
3.	In the **Position** screen highlight **Modify** and press .
4.	Select **Edit** and press to confirm.
5.	In the **Edit Position** screen enter a Point ID, a set of coordinates and the height of the desired Base Station. Select **Continue** and press to confirm.

Step	Description
6.	The instrument searches for base points in the vicinity, which are stored in the Base Point List.
7.	If there is already a Base Point within a 40 m radius of the measured point stored in the instrument a message is displayed: • Select **Overwrite** to use the newly measured position, or • select **Use existing** to use the known point. – In case the existing point has been chosen, a second warning message is displayed where you can choose between **Saved setup** to use the saved Base point setup, including Antenna and Communication settings, or **Current** to use the currently used Base point setup. If no Base Point is found within a 40 m radius an according information message is displayed and the newly entered information is stored as Base Point.

6.1.3 Base Setup using BasePilot

BasePilot setup

BasePilot is a feature which configures and starts the iCON gps 60 SmartAntenna running as a Base when the instrument (antenna) is setup over a known base point. Predefined base configurations are automatically loaded.

Step	Description
1.	According to your needs, setup the hardware needed over a known base point. Refer to "4 Setups with Accessories" for further information about hardware setup.
2.	• If iCON gps 60 SmartAntenna is in **Base** mode: – **BasePilot** starts up automatically. • If iCON gps 60 SmartAntenna is in **Rover** mode: – Go to **Settings** › **Tools** › **Base Setup** and choose **Find nearest**. – Press  to confirm. Refer to "6.1.2 Manual Base Setup" for further information.
3.	While **BasePilot** is setting up: The position icon  is displayed.
4.	After the **BasePilot** has been completed: The position icon  is displayed. **The radio/modem now starts transmitting corrections!** ☞ On **RTK Mode** page, in the **Position** submenu the line **BasePilot** shows: **Successful**.

☞ When using BasePilot, always check in the **Position** submenu that the iCON gps 60 SmartAntenna has selected the correct base point! **Using the wrong base point can lead to an error of more than 20 m for a rover!**

6.2 Rover Setup

Rover setup description

The instrument can be manually set up as a stand-alone Rover without a controller, using the Rover Setup wizard.

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen press and select the communication device using the ← and → navigation keys: • **Int. Radio**: Select this option to use the internal radio. A slot-in-radio must be inserted in its slot. Refer to "3.4 Slot-in-Device" for further information. • **Ext. Radio P1**: Select this option to use an external radio connected to Port P1. • **Int. Modem**: Select this option to use the internal modem. A SIM card must be inserted in the card slot. Refer to "3.3 Installing a SIM Card" for further information.
3.	Press to confirm your selection and use the → navigation key to proceed to the next step. ☞ The following step-by-step descriptions explain the different options in detail.

Rover setup with internal radio step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Int. Radio**.
3.	Use the → navigation key to proceed to the next step.
4.	In the **Internal Radio** screen select the **Channel** and the **Protocol**. Please note that **Protocol** is only available for the internal Satel radio TA13 and the external radio Satel GFU27. ☞ For an internal Satelline radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed.
5.	Use the → navigation key to proceed to the next step.
6.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Ref.Rec.** (Reference Receiver), the **Ref.Ant.** (Reference Antenna) and the **Accept Ref.** (Accepted References).
7.	Use the → navigation key to proceed to the next step.
8.	In the **Antenna** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
9.	Use the → navigation key to proceed to the final step.
10.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
11.	• Use the → navigation key to save and apply the rover settings. • To discard the changes press and confirm the following Warning by pressing on **Continue**.

Rover setup with external radio step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Ext. Radio P1**.
3.	Use the ➔ navigation key to proceed to the next step.
4.	In the **External Radio (1)** screen select the **Model**: • For generic radio setting (**Generic RS232**), where no device is auto-detected, select **Baud rate** and **Flow contr.**. • For external radios which are automatically detected, the **Model** is also selected automatically. In the **External Radio (2)** screen select the **Channel** and the **Protocol**. • For external radios which are not automatically detected, select the **Model** in the **External Radio (1)** screen and in the **External Radio (2)** screen select the **Channel** and the **Protocol**. ☞ For an external GFU27 radio the frequency can be set manually, when radio firmware version 06.17.3.61 or higher is installed.
5.	Use the ➔ navigation key to proceed to the next step.
6.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Ref.Rec.** (Reference Receiver), the **Ref.Ant.** (Reference Antenna) and the **Accept Ref.** (Accepted Reference ID).
7.	Use the ➔ navigation key to proceed to the next step.
8.	In the **Antenna** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
9.	Use the ➔ navigation key to proceed to the final step.
10.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
11.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press  and confirm the following Warning by pressing  on **Continue**.

Rover setup with internal modem using NTRIP Client step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Int. Modem**.
3.	Use the ➔ navigation key to proceed to the next step.
4.	In the **Int. Modem** screen select **NTRIP Client** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter **User ID** and **Password**.
5.	Use the ➔ navigation key to proceed to the next step.
6.	In the **NTRIP Settings** screen select the Address **Mode**, enter **Address**, **Port** number, **User** and **Password**. • Address mode WWW allows the entry of a web address. • Address mode IP allows the entry of an IP address.
7.	Use the ➔ navigation key to proceed to the next step.

Step	Description
8.	In the **Mount Point** screen select the **Method**. • If the Method **Source Table** is selected, then start the mount point search by selecting **Start** in the **Search** line. Once the source table has been downloaded, the desired mount point can be selected from the list available in the **Mountpoint** line. • If the Method **Manual** is selected, then it is possible to manually enter the mount point name.
9.	Use the ➔ navigation key to proceed to the next step.
10.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Network** type, the **Ref.Rec.** (Reference Receiver), and the **Ref.Ant.** (Reference Antenna).
11.	Use the ➔ navigation key to proceed to the next step.
12.	In the **Antenna** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
13.	Use the ➔ navigation key to proceed to the final step.
14.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
15.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press ESC and confirm the following Warning by pressing ↵ on **Continue**.

Rover setup with internal modem using TCP Client step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Int. Modem**.
3.	Use the ➔ navigation key to proceed to the next step.
4.	In the **Int. Modem** screen select **TCP Client** as **Mode**, enter **PIN**, **APN** (Access Point Name) and select **Use**/**Don't use** for the Provider ID. When **Use** is selected: • Use the ➔ navigation key to proceed to the next step. • In the **APN ID** screen enter the **User ID** and the **Password**.
5.	Use the ➔ navigation key to proceed to the next step.
6.	In the **Server Settings** screen select the Address **Mode**, enter **Address** and the **Port** number. • Address mode WWW allows the entry of a web address. • Address mode IP allows the entry of an IP address.
7.	Use the ➔ navigation key to proceed to the next step.
8.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Network** type, the **Ref.Rec.** (Reference Receiver), and the **Ref.Ant.** (Reference Antenna).
9.	Use the ➔ navigation key to proceed to the next step.
10.	In the **Antenna** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
11.	Use the ➔ navigation key to proceed to the final step.
12.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.

Step	Description
13.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press ESC and confirm the following Warning by pressing ↵ on **Continue**.

Rover setup with internal modem using DialUp step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **Rover Setup**.
2.	In the **Communication** screen select **Int. Modem**.
3.	Use the ➔ navigation key to proceed to the next step.
4.	In the **Int. Modem** screen select **DialUp** as **Mode**, enter **PIN** and **PUK**.
5.	Use the ➔ navigation key to proceed to the next step.
6.	In the **Dial-Up Settings** screen enter the **Ph. Number** and select the **Modem Prot.**, the **Net Data Rate**, and if the **Connection** should be transparent.
7.	Use the ➔ navigation key to proceed to the next step.
8.	In the **RTK Settings** screen select the **Corr.Format** (Correction Format), the **Ref.Rec.** (Reference Receiver), and the **Ref.Ant.** (Reference Antenna).
9.	Use the ➔ navigation key to proceed to the next step.
10.	In the **Antenna** screen select the active **Antenna**, the **Height** of the active antenna, and the **Measure** mode of antenna height. Refer to "3.9 Antenna Heights" for information about Antenna Heights.
11.	Use the ➔ navigation key to proceed to the final step.
12.	In the **Save Settings** screen the signal waves will flash if the **Channel** and the **Corr.Format** are correctly set.
13.	• Use the ➔ navigation key to save and apply the rover settings. • To discard the changes press ESC and confirm the following Warning by pressing ↵ on **Continue**.

6.3 ORP and NMEA Output

NMEA Output description

To transmit data using the NMEA standard protocol, the instrument must be configured accordingly.

☞ The appropriate position rate licences must be installed to access all output rates.

☞ The NMEA interface must be assigned to one of the serial ports.

NMEA Output settings step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **NMEA Output**.
2.	In the **NMEA Output** screen select **On**, **Off**, or **Edit** for each NMEA interface.
3.	When the NMEA Output settings have been done before, select **On** or **Off** to active/deactivate the output and press ↵ to confirm. Then press ESC to save the setting and return to the **Tools** menu.
4.	When the NMEA Output settings have not been done before, select **Edit** to start the NMEA Output wizard and confirm with ↵.

Step	Description
5.	Select **P1** as **Port** for the NMEA output. For the **Talker ID** select between **Auto** or **User**. When **User** is selected set the **User Talker ID** additionally. Finally select **Baud rate** and **Flow contr.**.
6.	Use the ➔ navigation key to proceed to the next step.
7.	For **ORP**, select **Off**, **Edit**, or set a rate. When **Edit** is selected: set the **Rate** and the **Coords** (coordinate format) additionally. • The **Height** is set automatically according to the coordinate system used: for WGS84 it is Ellipsoidal, and Orthometric for Local Grid. Refer to "Appendix B ORP – Orientation and Position" for further information about ORP. For **GGA**, **GGK**, **GGQ**, and **GLL** select **Off** or set a rate. Refer to "Appendix A NMEA Message Formats" for information about the different NMEA message formats.
8.	Use the ➔ navigation key to proceed to the next step.
9.	For **GNS**, **GSA**, **GSV**, **HDT**, and **LLK** select **Off** or set a rate. Refer to "Appendix A NMEA Message Formats" for information about the different NMEA message formats.
10.	Use the ➔ navigation key to proceed to the next step.
11.	For **LLQ**, **RMC**, **VTG**, and **ZDA** select **Off** or set a rate. Refer to "Appendix A NMEA Message Formats" for information about the different NMEA message formats.
12.	Use the ➔ navigation key to proceed to the final step.
13.	• To save the changes select **Save** and confirm with  . • To discard the changes select **Undo** and confirm with  .

ORP Output

The ORP output differs from standard NMEA messages:
- The ORP message is a Leica proprietary message and delivers position information of one or two antennas.

Configurable values
- **Rate**: Define the output rate.
- **Output**: It is possible to stream one position.
- **Coords** and **Height**: The available Height format depends on the selected Coordinate format. For local coordinates a "*.lok" file is required.

ORP settings can be accessed via **Settings** › **Tools** › **NMEA Output**. Toggle to **Edit** for **NMEA Out**. ORP is available on the second page of the wizard.
Refer to "Appendix B ORP – Orientation and Position" for further information about ORP.

6.4 Raw Data Logging

Raw Data logging

To log RINEX data the instrument must be configured for Raw Data logging. Access the settings via **Settings** › **Tools** › **Raw Data Logging**.

☞ RINEX is used for post processing when high accurate coodinates are required.

6.5 iCON Telematics

Description

With a connection between the iCON gps 60 SmartAntenna and the iCON telematics web page, **iCON Telematics** offers:

- **View**: Enables a remote user to access the iCON gps 60 SmartAntenna to view or control it.
- **Sync**: To exchange data between the iCON gps 60 SmartAntenna and a remote web page.
- **Track**: Enables a remote user to track the current position of the sensor.
- **Remote firmware upgrade**: Allows new instrument firmware files to be downloaded and installed remotely.

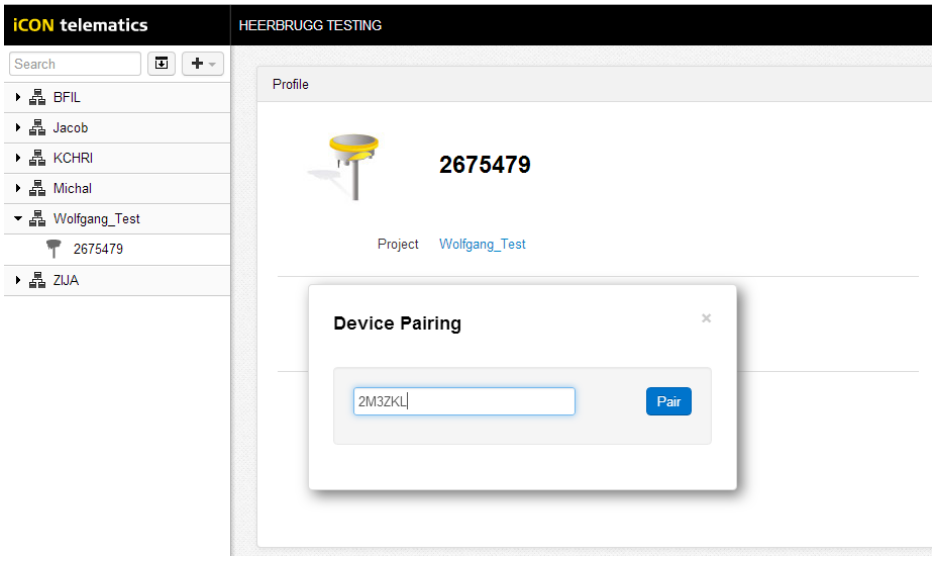
☞ To use this functionality an account is needed for the iCON telematics web page. The license is handled on the iCON gps 60 SmartAntenna. Ask your agency or your Leica Geosystems representative for information about licensing and how to get an account.

☞ An Internet connection on the iCON gps 60 SmartAntenna is needed, using a 3G modem. Refer to "3.3 Installing a SIM Card" for information about SIM card installation.

iCON Telematics first setup step-by-step

To use the **iCON Telematics** functionality perform following setup works in the given order:

Step	Description
1.	**Establish an Internet connection on the iCON gps 60 SmartAntenna, following these steps:** ☞ Refer to "3.3 Installing a SIM Card" for information about SIM card installation. • Access the wizard via **Settings** › **Tools** › **iCON Telematics** › **iCON Telematics Setup**. • In the **Internet conn.** screen, use the ➔ navigation key to proceed to the next step. • In the **Int. Modem** screen enter **PIN** and **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. • When **Use** is selected: – Use the ➔ navigation key to proceed to the next step. – In the **APN ID** screen enter **User ID** and **Password**. • Use the ➔ navigation key to proceed to the next step. • Ensure that **Server** is set to **icontelematics.com**. • Select **Start pairing ...** and press ↵ to confirm. • The software starts connecting to the selected Web page. After a successful connection the pairing code is displayed. Be sure to leave this screen open or note down the code.
☞	In case of failure, check **PIN** and **APN**.
2.	**Pair the iCON gps 60 SmartAntenna to the iCON telematics web page.** ☞ This is only necessary for the first time the iCON gps 60 SmartAntenna is connected to the iCON telematics web page.

Step	Description
3.	On the remote computer: • Start a web-browser. Google Chrome is recommended for best performance. • Go to the iCON telematics web page: **www.icontelematics.com**. • Use your **User name** and **Password** to login. ☞ To use this functionality an account is needed for the iCON telematics web page. The license is handled on the iCON gps 60 SmartAntenna. Ask your agency or your Leica Geosystems representative for information about licensing and how to get an account. • Now create a new **Unit**: – Tap the **+** icon and select **UNIT**. – Select the **Project**, that the Unit should be assigned to. If no project is available, create a project first. – Set **Vehicle type** to **GPS**, and **Type of equipment** to **GNSS Smart-Antenna**. – Enter a **Name** for the Unit. – **Different Unit properties** can optionally be entered to easily identify the unit. – Tap **Create** to create a Unit with the current settings. When successful, a confirmation is displayed. • Select the newly created Unit from the list. • To pair the iCON gps 60 SmartAntenna and the created (Web) Unit, tap and slide the key at **Device Paired** to **Yes**. • In the appearing **Device Pairing** window enter the pairing code displayed on the iCON gps 60 SmartAntenna. • Tap **Pair**. 

Step	Description
4.	On the iCON gps 60 SmartAntenna: • The screen with the pairing code should have been replaced by a confirmation that the instrument is paired with the server. The device is now paired/registered on the web page, and ready to connect. • Use the ➔ navigation key to proceed to the next step. • In the **Telematics Project** screen the selected **Project** is highlighted. If needed, select another project from the list. • Use the ➔ navigation key to proceed to the next step. • To allow to send the position of the paired iCON gps 60 SmartAntenna to the iCON telematics web page, set **Track** to **Yes**. Select the **Interval** as well in the **Telematics Track** screen. • Use the ➔ navigation key to proceed to the next step. • In the **Save Settings** screen use the ➔ navigation key to save the settings and exit the setup.
☞	The device is connected to the iCON telematics web page now and ready for **View**, **Sync** and **Track**. Information about the different functions can be found on the following paragraphs.

iCON Telematics Status

Use **Settings** › **Tools** › **iCON Telematics** › **iCON Telematics Status** to:
- enable or disable the **Share screen** function, to allow a remote user to view the iCON gps 60 SmartAntenna screen,
- view the status of **iCON Telematics** and its functions **View**, **Track** and **Sync**.

iCON Sync Download

1) To download data from the iCON telematics web page to the iCON gps 60 SmartAntenna select **Settings** › **Tools** › **iCON Telematics** › **iCON Sync Download**.
2) Set **Base Point List**, **Coord. Systems**, **Antenna List**, and **Licenses** according to your needs.
3) Use the ➔ navigation key to proceed to the next step.
4) Select **Start Download ...** and press  to confirm.

☞ Base point list, system configuration, antenna list and licences are automatically available after import on the iCON gps 60 SmartAntenna. The imported coordinate systems can be selected under **Settings** › **System Configuration** › **Coordinate systems** as active coordinate system.

☞ When copying files onto the iCON telematics server via the web page, it is important that the files are copied to the following folders: **Base point list** must be stored in **System**, while **Coordinate systems** must be stored in **CoordinateSystems/**.

iCON Sync Upload

1) To upload data from the iCON gps 60 SmartAntenna to the iCON telematics web page select **Settings** › **Tools** › **iCON Telematics** › **iCON Sync Upload**.
2) Set **Base Point List**, **System Config**, **Coord. Systems**, **Support Logs**, and **Raw Data Logs** according to your needs.
3) Use the ➔ navigation key to proceed to the next step.
4) Select **Start Upload ...** and press to confirm.

Uploaded data will be stored on the iCON telematics web page, inside the assigned project folder:
- The base point list will be stored at **System/iCG60-SN.bpl**.
- The system configuration will be stored at **System/iCG60-SN.cfg**.
- Coordinate systems will be stored at **CoordinateSystems/**.

- Support Logs will be stored at **Logging/logs-iCG60-SN/** and deleted from the iCON gps 60 SmartAntenna after successful upload.
- Raw Data Logs will be stored at **Logging/RINEX-iCG60-SN-yyyyMMdd** and be kept on the iCON gps 60 SmartAntenna after successful upload.

☞ SN stands for the Serial Number of the iCON gps 60 SmartAntenna, yyyyMMdd for the logging date.

iCON Telematics Firmware

1) To download a firmware version from the iCON telematics web page and install it on the iCON gps 60 SmartAntenna select **Settings** › **Tools** › **iCON Telematics** › **iCON Telematics Firmware**.
2) The software searches for available firmware on the iCON telematics web page.
3) If successful, select the firmware version needed, select **Start download ...** and press to confirm.
4) When download is completed, select **Install** and press to start installation.

☞ Ensure a proper power supply as the iCON gps 60 SmartAntenna will restart after the firmware installation.

☞ If **iCON Telematics** is enabled, the icon on the Main Menu automatically informs when a new firmware is available. Download and installation of the new firmware can also be started from within the **iCON Telematics** sub-menu, entered from the Main Menu.

iCON Telematics settings step-by-step

Step	Description
1.	Access the wizard via **Settings** › **Tools** › **iCON Telematics** › **iCON Telematics Setup**.
2.	In the **Internet conn.** screen, use the ➔ navigation key to proceed to the next step.
3.	In the **Int. Modem** screen enter **PIN** and **APN** (Access Point Name) and select **Use**/**Don't use** for the **APN ID**. • When **Use** is selected: – Use the ➔ navigation key to proceed to the next step. – In the **APN ID** screen enter **User ID** and **Password**.
4.	Use the ➔ navigation key to proceed to the next step.
5.	Ensure that **Server** is set to **icontelematics.com**.
6.	If required, select **Pair again ...** and press to confirm. After a successful connection, an appropriate message is displayed. Otherwise skip this step.
7.	Use the ➔ navigation key to proceed to the next step.
8.	In the **Telematics Project** screen select a **Project** from the list. ☞ System configuration, coordinate systems, support and raw data logfiles are stored within the selected project on the iCON telematics web page when using **iCON Sync Upload**.
9.	Use the ➔ navigation key to proceed to the next step.
10.	• To allow to send the position of the paired iCON gps 60 SmartAntenna to the iCON telematics web page, set **Track** to **Yes**. • Select the **Interval**.
11.	Use the ➔ navigation key to proceed to the next step.
12.	In the **Save Settings** screen use the ➔ navigation key to save the settings and exit the setup.

6.6 Import, Export, or Delete Data

Access the Import / Export / Delete function

Select **Settings** › **Tools** › **Import / Export / Delete** to import or export data from/to a USB Memory device installed in the iCON gps 60 SmartAntennas USB port or to delete data from the instruments internal memory.

Import data from USB

Select **Settings** › **Tools** › **Import / Export / Delete** › **Import from USB** to import data from a USB Memory device installed in the iCON gps 60 SmartAntennas USB port.

Import options	Description
Base point list	imports a list of base points
Antenna list	imports a list of external antennas
Welcome screen	imports a customisable welcome screen, for example a company logo
System configuration	overwrites the current system configuration
Coordinate systems	imports coordinate system files

☞ To import data from a USB Memory device to the iCON gps 60 SmartAntenna appropriate folders must be created on the USB device and the files placed in the correct folder: for Coordinate Systems a folder called **CoordinateSystems** is needed, while files for Base Point list, Antenna list, Welcome Screen, and System Configuration need to be placed in a **system** folder.

Export data to USB

Select **Settings** › **Tools** › **Import / Export / Delete** › **Export to USB** to export data to a USB Memory device installed in the iCON gps 60 SmartAntennas USB port.

Export options	Description
Base point list	exports a list of stored base points
System configuration	generates a backup of the current system configuration, for example to restore it in the future or to share settings to other instruments
Support logs	instrument related error messages are stored in the log file and can be exported
Coordinate systems	exports coordinate system files

☞ To export data to a USB Memory device no folders must be created on the device. The appropriate folders are automatically created by the software.

Delete data on the instrument

Select **Settings** › **Tools** › **Import / Export / Delete** › **Delete on instrument** to delete data from the instruments internal memory.

Delete options	Description
Base point list	deletes the list of stored base points
Antenna list	resets the list of external antennas to default values
Welcome screen	deletes the customised welcome screen
Support logs	removes all entries from the Support Log File
Coordinate systems	removes all Coordinate systems stored on the instrument

6.7 Licensing

Licences

In the **Licensing** menu active licenses can be viewed or deleted, licenses can be uploaded and a license key entered. Access the settings via **Settings** › **Tools** › **Licenses**.

Licenses can be ordered at your local sales representative. The following options are available for iCON gps 60 SmartAntenna:

- CSW501, RTK low Accuracy
- CSW502, RTK high Accuracy
- CSW503, Enables Base Station
- CSW504, Position update 2 Hz
- CSW505, Position update 10 Hz
- CSW506, Position update 20 Hz
- CSW507, RTK Baseline optional 2.5 km
- CSW508, RTK unlimited Baseline
- CSW509, RTK Network access
- CSW510, GPS L2 Support
- CSW511, GLONASS Support
- CSW512, GPS L5 Support
- CSW513, Galileo Support
- CSW514, BeiDou Support
- CSW515, Raw Data Logging
- CSW516, NMEA streaming
- CSW517, Open Interface
- CSW591, iCON telematics 1 Year
- CSW592, iCON telematics 2 Years
- CSW593, iCON telematics 3 Years
- CSW594, iCON telematics 1 Day
- CSW518, Demo License

7 Coordinate Systems

7.1 Overview

Description

GNSS measured points are always stored based on the global geocentric datum known as WGS 1984. Most surveys require coordinates in a local grid system. For example, based on a country's official mapping datum or an arbitrary grid system used in a particular area such as a construction site. To convert the WGS 1984 coordinates into local coordinates a coordinate system must be created. Part of the coordinate system is the transformation used to convert coordinates from the WGS 1984 datum to the local datum.

A coordinate system
- allows the conversion from WGS 1984 geodetic or cartesian coordinates to local grid coordinates and back.
- can be directly received from a reference network.
- can be uploaded from a USB Memory device.
- can be exported to a USB Memory device.

☞ Refer to "6.6 Import, Export, or Delete Data" for information about importing, exporting, or deleting coordinate systems.

Default coordinate systems

The default coordinate system is **WGS 1984**. It cannot be deleted. It is not possible to create a coordinate system called **WGS 1984**.
Additional default coordinate systems may be available for certain countries.

Active coordinate system

The active coordinate system is the one selected under **Settings** › **System Configuration** › **Coordinate systems**. One coordinate system is always considered as the active coordinate system.

Automatic coordinate system (RTCM transformation parameters)

When **Via Network** is selected under **Settings** › **System Configuration** › **Coordinate systems**, the coordinate system is directly received from the reference network via RTCM correction data.

☞ Reference networks do not always provide a coordinate system. This will depend on how the network provider has chosen to configure their data streams.

Coordinate system components

The iCON gps 60 SmartAntenna supports the same coordinate system formats as other Leica iCON products including iCON 3D, iCON Office and the iCONstruct field software.

Coordinate systems can be made up of up to three linked files:
- **.lok**: Localisation file, contains all the needed parameters and settings, for example datum, map projection and local transformation.
- **.ccg**: Correction grid (**C**ountry **S**pecific **C**oordinate **S**ystem model). Refer to "CSCS model (*.ccg)" for information about CSCS.
- **.grd**: Geoid model. Refer to "Geoid model" for further information.

Convert legacy Leica to iCON format

Converting legacy Leica coordinate system files into iCON format

To use the coordinate system files from legacy Leica Machine Control systems as well as Leica Viva systems in the iCON gps 60, or vice versa, it is necessary to convert the coordinate system files to the iCON format.

The following table compares the file types:

Type	Leica Redline, Viva, System1200	Leica iCON
Localisation file	TRFSET.DAT	.LOK
Correction grid	.CSCS	.CCG
Geoid model	.GEM	.GRD

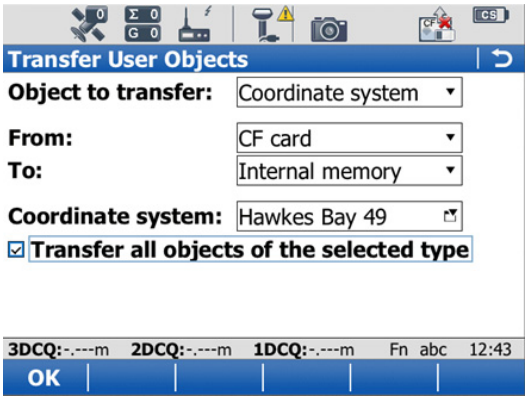
Convert TRFSET.DAT to *.XML for iCON gps 60

How to convert a TRFSET.DAT Coordinate System to *.XML for use in the iCON gps 60

- The conversion from TRFSET.DAT to *.XML is done via the common exchange format Hexagon LandXML ("HEXML").
- A TRFSET.DAT file can contain more than one coordinate system, while a *.XML file can only contain one coordinate system. Therefore the conversion below must be done one time for each coordinate system.
- Note that Geoids (.grd-file) and CSCS (.ccg-file) cannot be converted with this process. Please contact your local support representative for support in converting these files.

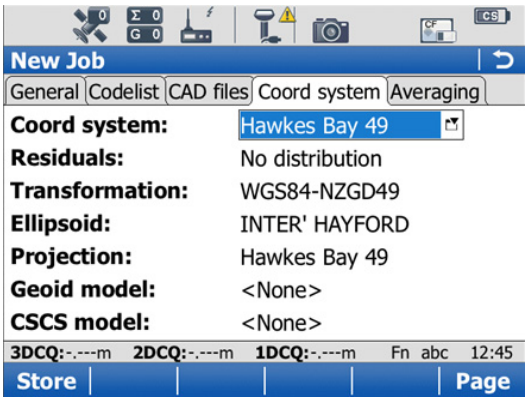
1. Import the TRFSET.DAT to Viva

- Make sure that the TRFSET.DAT file is in the correct folder, for example C:\Users\XXXX\Documents\System Viva\CS Viva\CF Card\DBX.
- From the **Main Menu**, go to *4* (**User**), *4* (**Tools & other utilities**), 1 (**Transfer user objects**).
- Apply the settings shown, and tap **OK**.

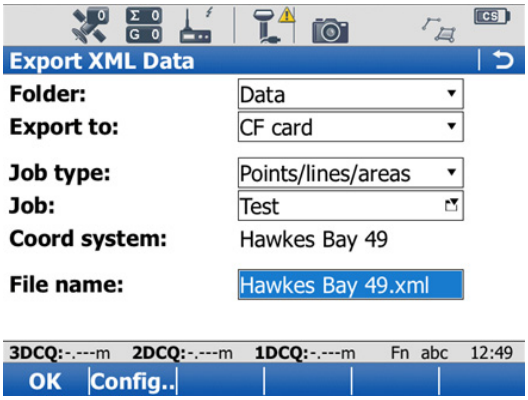


2. Export a coordinate system to XML

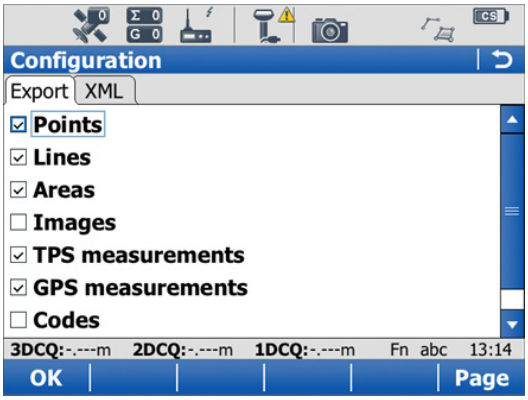
- From the **Main Menu**, go to 2 (**Jobs & Data**), 1 (**New job**) and give it a name.
- From the tab **Coord system** choose the coordinate system that should be exported, and press **Store**.



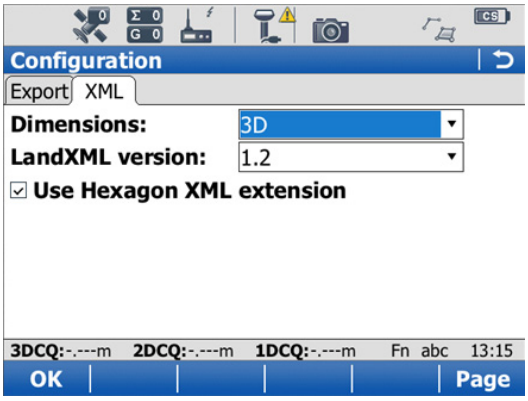
- Then from the **Main Menu**, go to 2 (**Jobs & Data**), 8 (**Export & copy data**), 4 (**Export XML data**).
- Apply the settings shown, give the XML-file the name of the coordinate system, then tap **Config..**.



- Apply the settings shown, and tap **OK**.



- Apply the settings shown, and tap **OK**.



3. **Copy the XML-file to a USB Memory device**
   - Locate the newly created XML-file in the folder C:\Users\XXXX\Documents\System Viva\CS Viva\CF Card\Data, and copy it to a USB Memory device (in a folder called **CoordinateSystems**).

4. **Import the XML-file to the iCON gps 60 SmartAntenna**
   - Attach the USB Memory device to the iCON gps 60 SmartAntennas USB port.
   - Start the iCON gps 60 SmartAntenna.
   - Select **Settings** › **Tools** › **Import / Export / Delete** › **Import from USB**.
   - Import the XML file from the USB Memory device to the iCON gps 60 SmartAntenna.

8 Care and Transport

8.1 Transport

Transport in the field

When transporting the equipment in the field, always make sure that you
- either carry the product in its original transport container,
- or carry the tripod with its legs splayed across your shoulder, keeping the attached product upright.

Transport in a road vehicle

Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container, original packaging or equivalent and secure it.

Shipping

When transporting the product by rail, air or sea, always use the complete original Leica Geosystems packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration.

Shipping, transport of batteries

When transporting or shipping batteries, the person in charge of the product must ensure that the applicable national and international rules and regulations are observed. Before transportation or shipping, contact your local passenger or freight transport company.

8.2 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to "Technical Data" for information about temperature limits.

Li-Ion batteries

- Refer to "Environmental specifications" for information about storage temperature range.
- Remove batteries from the product and the charger before storing.
- After storage recharge batteries before using.
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.
- A storage temperature range of 0°C to +30°C / +32°F to +86°F in a dry environment is recommended to minimize self-discharging of the battery.
- At the recommended storage temperature range, batteries containing a 40% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged.

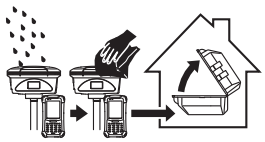
8.3 Cleaning and Drying

Product and accessories

- Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol. Do not use other liquids; these may attack the polymer components.

Damp products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40°C/104°F and clean them. Do not repack until everything is dry. Always close the transport container when using in the field.



Cables and plugs	Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.
Connectors with dust caps	Wet connectors must be dry before attaching the dust cap.

9 Technical Data

9.1 Technical Data iCON gps 60 SmartAntenna

9.1.1 Tracking Characteristics

Instrument technology

SmartTrack

Satellite reception

Triple frequency

Instrument channels and satellite tracking

- Up to 16 satellites in continuous tracking on L1, L2 and L5 (GPS).
- Up to 14 satellites in continuous tracking on L1 and L2 (GLONASS).
- Up to 14 satellites in continuous tracking on E1, E5a, E5b and Alt-BOC (Galileo).
- Four satellites when tracking SBAS (EGNOS, WAAS, MSAS, GAGAN).

☞ Depending on the satellite systems and signals configured, a maximum number of 120 channels is allocated.

Supported codes and phases

GPS

Type	L1	L2	L5
iCON gps 60 SmartAntenna	Carrier phase, C/A-code	Carrier phase, C code (L2C) and P2-code	Carrier phase, code

GLONASS

Type	L1	L2
iCON gps 60 SmartAntenna	Carrier phase, C/A-code	Carrier phase, P2-code

Galileo

Type	E1	E5a	E5b	Alt-BOC
iCON gps 60 SmartAntenna	Carrier phase, code	Carrier phase, code	Carrier phase, code	Carrier phase, code

☞ Carrier phase and code measurements on L1, L2 and L5 (GPS) are fully independent with AS on or off.

9.1.2 Accuracy

Accuracy is dependent upon various factors including the number of satellites tracked, constellation geometry, observation time, ephemeris accuracy, ionospheric disturbance, multipath and resolved ambiguities.

The following accuracies, given as **r**oot **m**ean **s**quare, are based on measurements processed using LGO and on real-time measurements.

The use of multiple GNSS systems can increase accuracy by up to 30% relative to GPS only.

Differential code

The baseline precision of a differential code solution for static and kinematic surveys is 25 cm.

Differential phase in post-processing

Static and rapid static

Static		Kinematic	
Horizontal	**Vertical**	**Horizontal**	**Vertical**
5 mm + 0.5 ppm	10 mm + 0.5 ppm	10 mm + 1 ppm	20 mm + 1 ppm

Static with long observations

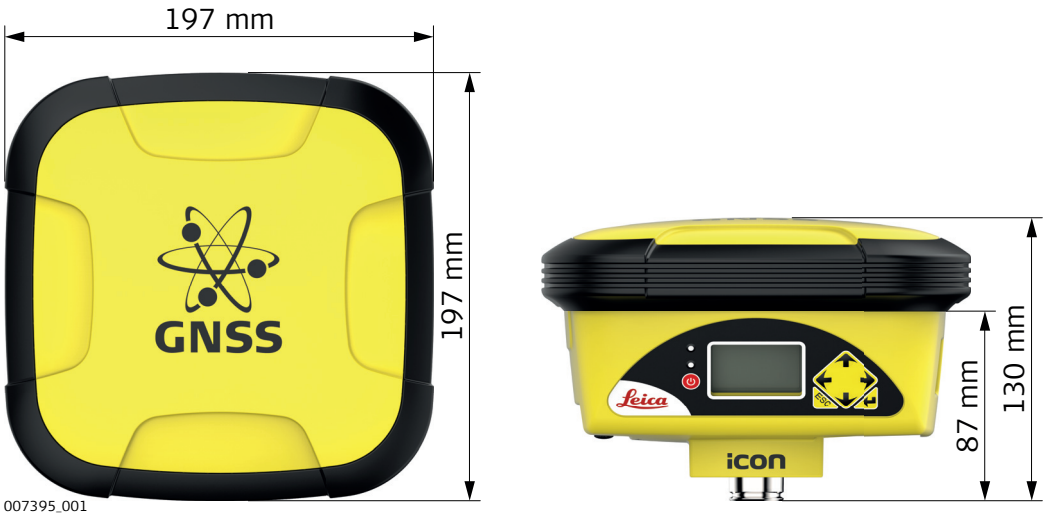
Static		Kinematic	
Horizontal	**Vertical**	**Horizontal**	**Vertical**
3 mm + 0.1 ppm	3.5 mm + 0.4 ppm	10 mm + 1 ppm	20 mm + 1 ppm

Differential phase in real-time

Type	Horizontal	Vertical
Single Baseline (< 30 km)	8 mm + 1 ppm	15 mm + 1 ppm
Network RTK	8 mm + 0.5 ppm	15 mm + 0.5 ppm

Dimensions

The overall dimensions are given for the housing including the sockets.



Type	Length [mm]	Width [mm]	Thickness [mm]
iCON gps 60 SmartAntenna	197	197	130

Weight

Instrument weight without battery:

Type	Weight [kg]/[lbs]
iCON gps 60 SmartAntenna	1.45/3.20 (including internal HSPA modem)

☞ The internal modem is installed by default.

Recording

Data (Leica GNSS raw data and RINEX data) can be recorded on the internal memory.

Capacity [MB]	Data capacity
• 466	466 MB is typically sufficient for about GPS only (12 satellites) • 3600 h L1 + L2 + L5 data logging at 15 s rate • 14000 h L1 + L2 + L5 data logging at 60 s rate GPS + GLONASS (12/8 satellites) • 3100 h data logging at 15 s rate • 12300 h data logging at 60 s rate GPS + GLONASS + Galileo (12/8/10 satellites) • 1400 h data logging at 15 s rate • 5800 h data logging at 60 s rate

Power

Power consumption:	iCON gps 60 SmartAntenna, radio excluded: 6 W typically, 500 mA
External supply voltage:	Nominal 12 V DC (⎓, GEV71 car battery cable to a 12 V car battery), voltage range 9 V-28 V DC

Internal battery

Type:	Li-Ion
Voltage:	7.4 V
Capacity:	GEB221/GEB222: 4.4 Ah/6.0 Ah

Battery external

Type:	NiMH
Voltage:	12 V
Capacity:	GEB171: 9.0 Ah

Operating times

The given operating times are valid for
- iCON gps 60 SmartAntenna: fully charged GEB221 battery.
- room temperature. Operating times will be shorter when working in cold weather.

Equipment			Operating time
Type	**Radio**	**Digital cellular phone**	
Static (iCON gps 60 SmartAntenna)	-	-	6 h continuously
Rover (iCON gps 60 SmartAntenna)	SATELLINE M3-TR1, receive (CCD7)	-	5 h continuously
Rover (iCON gps 60 SmartAntenna)	-	built-in HSPA Modem	4.75 h continuously

Electrical data

Type	iCON gps 60 SmartAntenna
Voltage	Nominal 12 V
Current	6.0 W typically, 12 V @ 500 mA
Frequency	GPS L1 1575.42 MHz GPS L2 1227.60 MHz GPS L5 1176.45 MHz GLONASS L1 1602.5625 MHz - 1611.5 MHz GLONASS L2 1246.4375 MHz - 1254.3 MHz Galileo E1 1575.42 MHz Galileo E5a 1176.45 MHz Galileo E5b 1207.14 MHz Galileo Alt-BOC 1191.795 MHz BeiDou B1 1561.098 MHz BeiDou B2 1207.14 MHz BeiDou B3 1268.52 MHz WCDMA 900 Rx: 925 MHz - 960 MHz Tx: 880 MHz - 915 MHz WCDMA 800 Rx: 875 MHz - 885 MHz Tx: 830 MHz - 840 MHz WCDMA 850 Rx: 869 MHz - 894 MHz Tx: 824 MHz - 849 MHz WCDMA 1900 Rx: 1930 MHz - 1990 MHz Tx: 1850 MHz - 1910 MHz

Type	iCON gps 60 SmartAntenna
	WCDMA 2100 Rx: 2110 MHz - 2170 MHz Tx: 1920 MHz - 1980 MHz GSM 850 Rx: 869 MHz - 894 MHz Tx: 824 MHz - 849 MHz EGSM 900 Rx: 925 MHz - 960 MHz Tx: 880 MHz - 915 MHz GSM 1800 Rx: 1805 MHz - 1880 MHz Tx: 1710 MHz - 1785 MHz GSM 1900 Rx: 1930 MHz - 1990 MHz Tx: 1850 MHz - 1910 MHz Bluetooth 2400 MHz - 2483.5 MHz
Gain	Typically 27 dBi
Noise Figure	Typically < 2 dBi

☞ For corresponding information for optional, internal radios refer to their specifications.

☞ Galileo Alt-BOC covers bandwidth of Galileo E5a and E5b.

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
Instrument	-40 to +60	-40 to +80
Internal GSM-Modem	-25 to +60	-30 to +85
Battery internal	-20 to +55	-40 to +70

Protection against water, dust and sand

Type	Protection
Instrument	IP67 (IEC 60529) Dust tight Waterproof to 1 m temporary immersion

Humidity

Type	Protection
Instrument	Up to 100 % The effects of condensation are to be effectively counteracted by periodically drying out the instrument.

Vibration/Shock

Type	iCON gps 60 SmartAntenna
Vibration	MIL-STD 810F, Figure 514.5C-3
Shock	40 g - 6 msec; compliance ISO 9022-31-06, No loss of lock to satellite signal when used on a pole set-up and submitted to pole bumps up to 150 mm

Type	iCON gps 60 SmartAntenna
Drops Withstands	1.2 m drop onto hard surfaces
Topple over Withstands	Topple over from a 2 m pole onto hard surfaces

9.2 Antennas Technical Data

Description and use

The GNSS antenna is selected for use based upon the application. The table gives a description and the intended use of the antenna.

Type	Description	Use
CGA60	GPS, GLONASS, Galileo, BeiDou SmartRack+ antenna with built-in ground plane.	Machine Control, RTK Base Station, RTK Rover and Network RTK applications.

Dimensions

Type	CGA60
Height	62 mm
Diameter	170 mm

Connector

TNC female

Mounting

5/8" Whitworth

Weight

0.4 kg

Electrical data

Type	CGA60
Voltage	4.5 V to 18 V DC
Current	35 mA typical
Frequency	
GPS L1	1575.42 MHz
GPS L2	1227.60 MHz
GPS L5	1176.45 MHz
GLONASS L1	1602.5625 - 1611.5 MHz
GLONASS L2	1246.4375 - 1254.3 MHz
Galileo E1	1575.42 MHz
Galileo E5a	1176.45 MHz
Galileo E5b	1207.14 MHz
Galileo Alt-BOC	1191.795 MHz
BeiDou B1	1561.098 MHz
BeiDou B2	1207.14 MHz
BeiDou B3	1268.52 MHz
Gain (typically)	27 dBi
Noise Figure (typically)	< 2 dBi

☞ Galileo Alt-BOC covers bandwidth of Galileo E5a and E5b.

Environmental specifications

Temperature

Type	Operating temperature [°C]	Storage temperature [°C]
CGA60	-40 to +70	-55 to +85

Protection against water, dust and sand

Type	Protection
CGA60	IP67 (IEC 60529) Dust tight Protected against water jets Waterproof to 1 m temporary immersion

Humidity

Type	Protection
CGA60	Up to 100 % The effects of condensation are to be effectively counteracted by periodically drying out the antenna.

Vibration/Shock

Type	CGA60
Vibration	10 - 10000 Hz, ± 1.5 mm, 10 g 8 - 150 Hz, ± 15 mm, 15 g ISO9022-36-08 MIL-STD 810F – 514.5-Cat24
Shock	100 g, 2 ms

Cable length

Separation distance from instrument ...	to antenna	Optional cable lengths [m]
iCON gps 60	CGA60	2.8, 5, 10

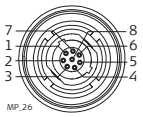
Expert knowledge required

Modification or adaption on base of the pin assignments and socket descriptions need expert knowledge.

WARNING

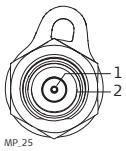
Changes or modifications not expressly approved by Leica Geosystems for compliance could void the user's authority to operate the equipment.

Port 1- Lemo



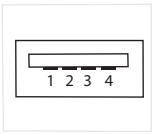
Pin	Name	Function	Direction
1	RTS	RS232, **R**equest **T**o **S**end	Out
2	CTS	RS232, **C**lear **T**o **S**end	In
3	GND	Ground	-
4	RxD	RS232, receive data	In
5	TxD	RS232, transmit data	Out
6	ID	Identification pin	In
7	PWR in	Power in, 9 to 28 V DC	In
8	+12 V out	12 V DC power supply out	Out

ANT



Pin	Description
1	Antenna signal and antenna power
2	Shield/Ground

USB 2.0 host connector



Type: USB-A receptacle

Pin	Name	Description	Direction
1	+5V	+5V Power supply	Out
2	D-	Data signal negative	In/Out
3	D+	Data signal positive	In/Out
4	GND	Power supply return and signals reference	In

Picture: Receptacle viewed from mating side.

9.4 Conformity Declarations

Conformity to national regulations

For products which do not fall under R&TTE directive:

Hereby, Leica Geosystems AG, declares that the product/s is/are in compliance with the essential requirements and other relevant provisions of the applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.

- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

9.4.1 iCON gps 60

Conformity to national regulations

- FCC Part 15, 22 and 24 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product iCON gps 60 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.

Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.

- The conformity for countries with other national regulations not covered by the FCC part 15, 22 and 24 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

Type	Frequency band [MHz]
Bluetooth	2402 - 2480

Output power

Type	Output power [mW]
Bluetooth	2.5

Antenna

Type	Antenna	Gain [dBi]	Connector	Frequency band [MHz]
Bluetooth	Integrated antenna	-	-	2402 - 2480

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product GFU14, GFU27 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorisation for use:
  - France
  - Italy
  - Norway (if used in the geographical area within a radius of 20km from the centre of Ny-Ålesund)
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

403 MHz - 470 MHz

Output power

GFU14, GFU27: 0.5 W - 1.0 W

Antenna

Type	Internal	GAT1	GAT2
Frequency band [MHz]	400 - 470	400 - 435	435 - 470
Type	Internal	Detachable λ/2 antenna	Detachable λ/2 antenna
Connector	-	TNC	TNC

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product GFU15 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorisation for use:
  - France
  - Italy
  - Norway (if used in the geographical area within a radius of 20km from the centre of Ny-Ålesund)
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

403 MHz - 470 MHz

Output power

Receive only

Antenna

Type	Internal	GAT1	GAT2
Frequency band [MHz]	400 - 470	400 - 435	435 - 470
Type	Internal	Detachable λ/2 antenna	Detachable λ/2 antenna
Connector	-	TNC	TNC

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product TFR-300L is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorisation for use:
  - France
  - Italy
  - Norway (if used in the geographical area within a radius of 20km from the centre of Ny-Ålesund)
- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

403 MHz - 470 MHz

Output power

Receive only

Antenna

Type	Internal	GAT1	GAT2
Frequency band [MHz]	400 - 470	400 - 435	435 - 470
Type	Internal	Detachable λ/2 antenna	Detachable λ/2 antenna
Connector	-	TNC	TNC

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product CCD7 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.
- This Class 2 equipment may be operated in: AT, BE, CY, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, SK, SI, ES, SE, GB, IS, LI, NO, CH, BG, RO and TR.

Class 2 equipment according European Directive 1999/5/EC (R&TTE) for which following EEA Member States apply restrictions on the placing on the market or on the putting into service or require authorisation for use:

- France
- Italy
- Norway (if used in the geographical area within a radius of 20km from the centre of Ny-Ålesund)

- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

403 MHz - 470 MHz

Output power

0.5 W - 1.0 W

Antenna

Type	GAT1	GAT2	CA12
Frequency band [MHz]	400 - 435	435 - 470	406 - 440
Type	Detachable λ/2 antenna	Detachable λ/2 antenna	External stub antenna
Connector	TNC	TNC	TNC (CA11, Magnetic antenna mount)

Specific Absorption Rate (SAR)

The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

9.4.6 Sierra MC8795V

Conformity to national regulations

- FCC Part 15 (applicable in US)
- Hereby, Leica Geosystems AG, declares that the product Sierra MC8795V is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC and other applicable European Directives. The declaration of conformity can be consulted at http://www.leica-geosystems.com/ce.

Class 1 equipment according European Directive 1999/5/EC (R&TTE) can be placed on the market and be put into service without restrictions in any EEA member state.

- The conformity for countries with other national regulations not covered by the FCC part 15 or European directive 1999/5/EC has to be approved prior to use and operation.
- Japanese Radio Law and Japanese Telecommunications Business Law Compliance.
  - This device is granted pursuant to the Japanese Radio Law and the Japanese Telecommunications Business Law.
  - This device should not be modified (otherwise the granted designation number will become invalid).

Frequency band

WCDMA:	WCDMA 900 Rx: 925 MHz - 960 MHz Tx: 880 MHz - 915 MHz WCDMA 800 Rx: 875 MHz - 885 MHz Tx: 830 MHz - 840 MHz WCDMA 850 Rx: 869 MHz - 894 MHz Tx: 824 MHz - 849 MHz WCDMA 1900 Rx: 1930 MHz - 1990 MHz Tx: 1850 MHz - 1910 MHz WCDMA 2100 Rx: 2110 MHz - 2170 MHz Tx: 1920 MHz - 1980 MHz
GSM:	GSM 850 Rx: 869 MHz - 894 MHz Tx: 824 MHz - 849 MHz EGSM 900 Rx: 925 MHz - 960 MHz Tx: 880 MHz - 915 MHz GSM 1800 Rx: 1805 MHz - 1880 MHz Tx: 1710 MHz - 1785 MHz GSM 1900 Rx: 1930 MHz - 1990 MHz Tx: 1850 MHz - 1910 MHz

Output power

GSM / EDGE, UMTS: 32 dBm

Antenna

- Internal antenna
- Frequency band [MHz]: 824 - 960 / 1710 -2170
- Connector: none

Specific Absorption Rate (SAR)	The product meets the limits for the maximum permissible exposure of the guide-lines and standards which are force in this respect. The product must be used with the recommended antenna. A separation distance of at least 20 centimetres should be kept between the antenna and the body of the user or nearby person within the intended application.

10 Software Licence Agreement

Software Licence Agreement

This product contains software that is preinstalled on the product, or that is supplied to you on a data carrier medium, or that can be downloaded by you online according to prior authorisation from Leica Geosystems. Such software is protected by copyright and other laws and its use is defined and regulated by the Leica Geosystems Software Licence Agreement, which covers aspects such as, but not limited to, Scope of the Licence, Warranty, Intellectual Property Rights, Limitation of Liability, Exclusion of other Assurances, Governing Law and Place of Jurisdiction. Please make sure, that at any time you fully comply with the terms and conditions of the Leica Geosystems Software Licence Agreement.

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You must not install or use the software unless you have read and accepted the terms and conditions of the Leica Geosystems Software Licence Agreement. Installation or use of the software or any part thereof, is deemed to be an acceptance of all the terms and conditions of such Licence Agreement. If you do not agree to all or some of the terms of such Licence Agreement, you must not download, install or use the software and you must return the unused software together with its accompanying documentation and the purchase receipt to the distributor from whom you purchased the product within ten (10) days of purchase to obtain a full refund of the purchase price.

Open source information

The software on the product may contain copyright-protected software that is licensed under various open source licences.
Copies of the corresponding licences

- are provided together with the product (for example in the About panel of the software)
- can be downloaded on http://opensource.leica-geosystems.com/icon

If foreseen in the corresponding open source licence, you may obtain the corresponding source code and other related data on http://opensource.leica-geosystems.com/icon.
Contact opensource@leica-geosystems.com in case you need additional information.

Appendix A NMEA Message Formats

A.1 Overview

Description

National **M**arine **E**lectronics **A**ssociation is a standard for interfacing marine electronic devices. This chapter describes all NMEA-0183 messages which can be output by the instrument.

Access

Select **Settings > Tools > NMEA Output**.

☞

A Talker ID appears at the beginning of the header of each NMEA message.
The Talker ID can be user defined or standard (based on the NMEA 3.0). The standard is normally GP for GPS but can be changed in **Settings > Tools > NMEA Output**.

A.2 Symbols Used for Describing the NMEA Formats

Description

NMEA messages consist of various fields. The fields are:

- Header
- Special format fields
- Numeric value fields
- Information fields
- Null fields

Certain symbols are used as identifier for the field types.
These symbols are described in this section.

Header

Symbol	Field	Description	Example
$	-	Start of sentence	$
--ccc	Address	• -- = alphanumeric characters identifying the talker Options: GN = **G**lobal **N**avigation **S**atellite **S**ystem GP = GPS only GL = GLONASS GA = Galileo BD = BeiDou • ccc = alphanumeric characters identifying the data type and string format of the successive fields. Usually the name of the message.	 GNGGA GPGGA GLGGA GAGGA BDGGA

Special format fields

Symbol	Field	Description	Example
A	Status	• A = Yes, Data Valid, Warning Flag Clear • V = No, Data Invalid, Warning Flag Set	V
llll.ll	Latitude	• Degreesminutes.decimal • Two fixed digits of degrees, two fixed digits of minutes and a variable number of digits for decimal fraction of minutes. • Leading zeros are always included for degrees and minutes to maintain fixed length.	4724.538950
yyyyy.yy	Longitude	• Degreesminutes.decimal • Three fixed digits of degrees, two fixed digits of minutes and a variable number of digits for decimal fraction of minutes. • Leading zeros are always included for degrees and minutes to maintain fixed length.	00937.046785
eeeeee.eee	Grid Easting	At the most six fixed digits for metres and three fixed digits for decimal fractions of metres.	195233.507
nnnnnn.nnn	Grid Northing	At the most six fixed digits for metres and three fixed digits for decimal fractions of metres.	127223.793
hhmmss.ss	Time	• hoursminutesseconds.decimal • Two fixed digits of hours, two fixed digits of minutes, two fixed digits of seconds and a variable number of digits for decimal fraction of seconds. • Leading zeros are always included for hours, minutes and seconds to maintain fixed length.	115744.00
mmddyy	Date	• Monthdayyear - two fixed digits of month, two fixed digits of day, two fixed digits of year. • Leading zeros always included for month, day and year to maintain fixed length.	093003
No specific symbol	Defined field	• Some fields are specified to contain predefined constants, most often alpha characters. • Such a field is indicated by the presence of one or more valid characters. Excluded from the list of valid characters are the following that are used to indicate other field types: A, a, c, x, hh, hhmmss.ss, llll.ll, yyyyy.yy.	M

Numeric value fields

Symbol	Field	Description	Example
x.x	Variable numbers	• Integer or floating numeric field • Optional leading and trailing zeros. Decimal point and associated decimal-fraction are optional if full resolution is not required.	73.10 = 73.1 = 073.1 = 73
hh_	Fixed HEX field	Fixed length HEX numbers	3F

Information fields

Symbol	Field	Description	Example
c--c	Variable text	Variable length valid character field	A
aa_	Fixed alpha field	Fixed length field of upper case or lower case alpha characters	N
xx_	Fixed number field	Fixed length field of numeric characters	1

Null fields

Symbol	Field	Description	Example
No symbol	Information unavailable for output	Null fields do not contain any information.	,,

☞ Fields are always separated by a comma. Before the Checksum field there is never a comma.

☞ When information for a field is not available, the position in the data string is empty.

A.3 GGA - Global Positioning System Fix Data

Syntax

$--GGA,hhmmss.ss,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>

Description of fields

Field	Description
$--GGA	Header including Talker ID
hhmmss.ss	UTC time of position
llll.ll	Latitude (WGS 1984)
a	Hemisphere, **N**orth or **S**outh
yyyyy.yy	Longitude (WGS 1984)
a	**E**ast or **W**est
x	Position quality indicator 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Valid fix for GNSS**P**recise **P**ositioning **S**ervice mode, for example WAAS 4 = Real-time position, ambiguities fixed
xx	Number of satellites in use. For $GNGGA messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
x.x	HDOP
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported.
M	Units of altitude as fixed text M
x.x	Geoidal separation in metres. The Geoidal separation is the difference between the WGS 1984 earth ellipsoid surface and mean sea level.
M	Units of geoidal separation as fixed text M
x.x	Age of differential GNSS data, empty when DGPS not used
xxxx	Differential base station ID, 0000 to 1023
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

User-defined Talker ID = GN

$GNGGA,113805.50,4724.5248541,N,00937.1063044,E,4,13,0.7,1171.281,M,-703.398,
M,0.26,0000*42

Syntax

$--GGK,hhmmss.ss,mmddyy,llll.ll,a,yyyyy.yy,a,x,xx,x.x,EHTx.x,M*hh<CR><LF>

Description of fields

Field	Description
$--GGK	Header including Talker ID
hhmmss.ss	UTC time of position
mmddyy	UTC date
llll.ll	Latitude (WGS 1984)
a	Hemisphere, **N**orth or **S**outh
yyyyy.yy	Longitude (WGS 1984)
a	**E**ast or **W**est
x	Position quality indicator 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed 5 = Real-time position, float
xx	Number of satellites in use. For $GNGGK messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
x.x	GDOP
EHT	Ellipsoidal height
x.x	Altitude of position marker as local ellipsoidal height. If the local ellipsoidal height is not available, the WGS 1984 ellipsoidal height will be exported.
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

Standard Talker ID

$GNGGK,113616.00,041006,4724.5248557,N,00937.1063064,E,3,12,1.7,EHT1171.742,M*6D

User-defined Talker ID = GN

$GNGGK,113806.00,041006,4724.5248557,N,00937.1063064,E,3,13,1.4,EHT1171.746,M*66

A.5 GGQ - Real-Time Position with CQ

Syntax

$--GGQ,hhmmss.ss,mmddyy,llll.ll,a,yyyyy.yy,a,x,xx,x.x,x.x,M*hh<CR><LF>

Description of fields

Field	Description
$--GGQ	Header including talker ID
hhmmss.ss	UTC time of position
mmddyy	UTC date
llll.ll	Latitude (WGS 1984)
a	Hemisphere, **N**orth or **S**outh
yyyyy.yy	Longitude (WGS 1984)
a	**E**ast or **W**est
x	Position quality indicator 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed 5 = Real-time position, float
xx	Number of satellites in use. For $GNGGQ messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
x.x	Coordinate quality in metres
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported.
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

For NMEA v4.0:

Standard Talker ID

$GNGGQ,113615.50,041006,4724.5248556,N,00937.1063059,E,3,12,0.009,1171.281,M*22
$GPGGQ,113615.50,041006,,,,08,,*67
$GLGGQ,113615.50,041006,,,,04,,*77

User-defined Talker ID = GN

$GNGGQ,113805.50,041006,4724.5248541,N,00937.1063044,E,3,13,0.010,1171.281,M*2E

For NMEA v4.1:

$GNGGQ,113615.50,041006,4724.5248556,N,00937.1063059,E,3,12,0.009,1171.281,M*22

☞ Only the $GNGGQ is output when more than one GNSS is active.

A.6 GLL - Geographic Position Latitude/Longitude

Syntax

$--GLL,llll.ll,a,yyyyy.yy,a,hhmmss.ss,A,a*hh<CR><LF>

Description of fields

Field	Description
$--GLL	Header including talker ID
llll.ll	Latitude (WGS 1984)
a	Hemisphere, **N**orth or **S**outh
yyyyy.yy	Longitude (WGS 1984)
a	**E**ast or **W**est
hhmmss.ss	UTC time of position
A	Status A = Data valid V = Data not valid
a	Mode indicator A = Autonomous mode D = Differential mode N = Data not valid
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

☞ The Mode indicator field supplements the Status field. The Status field is set to A for the Mode indicators A and D. The Status field is set to V for the Mode indicator N.

Examples

Standard Talker ID
$GNGLL,4724.5248556,N,00937.1063059,E,113615.50,A,D*7B
User-defined Talker ID = GN
$GNGLL,4724.5248541,N,00937.1063044,E,113805.50,A,D*7E

A.7 GNS - GNSS Fix Data

Syntax

$--GNS,hhmmss.ss,llll.ll,a,yyyyy.yy,a,c--c,xx,x.x,x.x,x.x,x.x,xxxx,h*hh<CR><LF>

Description of fields

Field	Description
$--GNS	Header including talker ID
hhmmss.ss	UTC time of position
llll.ll	Latitude (WGS 1984)
a	Hemisphere, **N**orth or **S**outh
yyyyy.yy	Longitude (WGS 1984)
a	**E**ast or **W**est
c--c	For NMEA v4.1 in use. Four character mode indicator for each GNSS constellation used in the position where the

Field	Description
	• First character is for GPS • Second character is for GLONASS • Third character is for Galileo • Fourth character is for BeiDou N = Satellite system not used in position fix or fix not valid P = Precise, for example no deliberate degradation such as SA A = Autonomous; navigation fix, no real-time fix D = Differential; real-time position, ambiguities not fixed R = Real-time kinematic; ambiguities fixed F = Float real-time kinematic
xx	Number of satellites in use. For $GNGGA messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
x.x	HDOP
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported. If the local ellipsoidal height is not available either, the WGS 1984 ellipsoidal height will be exported.
x.x	Geoidal separation in metres
x.x	Age of differential data
xxxx	Differential base station ID, 0000 to 1023
h	For NMEA v4.1. Navigation Status Indicator S = Safe C = Caution U = Unstable V = Navigation status not valid
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

For NMEA v4.0:

Standard Talker ID

$GNGNS,113616.00,4724.5248557,N,00937.1063064,E,RR,12,0.9,1171.279,-703.398,0.76,0000*6C

$GPGNS,113616.00,,,,,,08,,,,,*69

$GLGNS,113616.00,,,,,,04,,,,,*79

☞ Only the $GNGNS is output when more than one GNSS is active.

User-defined Talker ID = GN

$GNGNS,113806.00,4724.5248547,N,00937.1063032,E,R,13,0.7,1171.283,-703.398,0.76,0000*39

For NMEA v4.1:

$GNGNS,113616.00,4724.5248557,N,00937.1063064,E,RR,12,0.9,1171.279,-703.398,0.76,0000,V*6C

☞ Only the $GNGNS is output when more than one GNSS is active.

Syntax

$--GSA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x,h*hh<CR><LF>

Description of fields

Field	Description
$--GSA	Header including talker ID
a	Mode M = Manual, forced to operate in 2D or 3D mode A = Automatic, allowed to change automatically between 2D and 3D
x	Mode 1 = Fix not available 2 = 2D 3 = 3D
xx	PRN numbers of the satellites used in the solution. For NMEA v4.0: This field is repeated 12 times. For NMEA v4.1: This field is repeated 16 times. ☞ A new GSA message is sent for each GNSS constellation tracked. **For NMEA v4.0 and v4.1:** GPS 1 to 32 GPS satellites 33 to 64 SBAS satellites 65 to 99 Undefined GLONASS 1 to 32 Undefined 33 to 64 SBAS satellites 65 to 99 GLONASS satellites **For NMEA v4.1 also:** Galileo 1 to 36 Galileo satellites 37 to 64 Galileo SBAS 65 to 99 Undefined BeiDou 1 to 37 BeiDou satellites 38 to 64 BeiDou SBAS 65 to 99 Undefined
x.x	PDOP
x.x	HDOP
x.x	VDOP
h	For NMEA v4.1. GNSS System ID 1 = GPS 2 = GLONASS 3 = Galileo 4 = BeiDou
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

For NMEA v4.0:

Standard Talker ID

$GNGSA,A,3,01,11,14,17,19,20,24,28,,,,,1.5,0.9,1.2*26
$GNGSA,A,3,65,66,67,81,,,,,,,,,1.5,0.9,1.2*29

User-defined Talker ID = GN

$GNGSA,A,3,01,11,14,17,19,20,23,24,28,,,,65,66,67,81,,,,,,,,1.2,0.7,1.0*27

For NMEA v4.1:

$GNGSA,A,3,01,04,10,11,13,20,23,31,,,,,,,,1.1,0.6,0.9,1*39
$GNGSA,A,3,66,67,68,7,6,77,81,82,83,,,,,,,,1.1,0.6,0.9,2*3B
$GNGSA,A,3,05,10,14,,,,,,,,,,,,1.1,0.6,0.9,4*3A

A.9 GSV - GNSS Satellites in View

Syntax

$--GSV,x,x,xx,xx,xx,xxx,xx,.....,h*hh<CR><LF>

Description of fields

Field	Description
$--GSV	Header including talker ID
x	Total number of messages, 1 to 9
x	Message number, 1 to 9
xx	Number of theoretically visible satellites according to the current almanac.
xx	PRN numbers of the satellites used in the solution. GPS 1 to 32 GPS satellites 33 to 64 SBAS satellites 65 to 99 Undefined GLONASS 1 to 32 Undefined 33 to 64 SBAS satellites 65 to 99 GLONASS satellites Galileo 1 to 36 Galileo satellites 37 to 64 Galileo SBAS 65 to 99 Undefined BeiDou 1 to 37 BeiDou satellites 38 to 64 BeiDou SBAS 65 to 99 Undefined
xx	Elevation in degrees, 90 maximum, empty when not tracking
xxx	Azimuth in degrees true north, 000 to 359, empty when not tracking
xx	**S**ignal to **N**oise **R**ation C/No in dB, 00 to 99 of L1 signal, null field when not tracking.
...	Repeat set PRN / Slot number, elevation, azimuth and SNR up to four times
h	For NMEA v4.1. Signal ID GPS 0 All signals 1 L1 C/A 2 L1 P(Y) 3 L1M

Field	Description		
		4	L2 P(Y)
		5	L2C-M
		6	L2C-L
		7	L5-I
		8	L5-Q
		9-F	Reserved
	GLONASS	0	All signals
		1	G1 C/A
		2	G1 P
		3	G2 C/A
		4	GLONASS (M) G2 P
		5-F	Reserved
	Galileo	0	All signals
		1	E5a
		2	E5b
		3	E5a+b
		4	E6-A
		5	E6-BC
		6	L1-A
		7	L1-BC
		8-F	Reserved
	BeiDou	0	All signals
		1-F	Reserved
*hh	Checksum		
<CR>	**C**arriage **R**eturn		
<LF>	**L**ine **F**eed		

☞ Satellite information can require the transmission of multiple messages, specified by the total number of messages and the message number.

☞ The fields for the PRN / Slot number, Elevation, Azimuth and SNR form one set. A variable number of these sets are allowed up to a maximum of four sets per message.

Examples

For NMEA v4.0:

Standard Talker ID

$GPGSV,3,1,11,01,55,102,51,11,85,270,50,14,31,049,47,17,21,316,46*7A
$GPGSV,3,2,11,19,31,172,48,20,51,249,50,22,00,061,,23,11,190,42*7E
$GPGSV,3,3,11,24,11,292,43,25,08,114,,28,14,275,44,,,,*45
$GLGSV,2,1,06,65,16,055,42,66,64,025,48,67,46,262,42,68,01,245,*64
$GLGSV,2,2,06,81,52,197,47,83,07,335,,,,,,,,*68

User-defined Talker ID = GN

$GNGSV,3,1,10,01,55,100,51,11,86,263,50,14,31,049,47,17,22,316,46*65
$GNGSV,3,2,10,19,30,172,48,20,52,249,51,23,12,190,42,24,12,292,42*6C
$GNGSV,3,3,10,25,09,114,,28,14,274,44,,,,,,,,*62

For NMEA v4.1:
$GPGSV,3,1,10,01,27,152,45,04,40,303,50,10,16,281,44,11,03,158,,0*62
$GPGSV,3,2,10,13,51,215,50,17,27,250,,20,59,089,51,23,84,143,52,0*63
$GPGSV,3,3,10,31,19,041,41,32,21,089,44,,,,,,,,0*6D
$GLGSV,3,1,10,66,28,068,47,67,68,359,48,68,31,280,43,75,07,011,,0*75
$GLGSV,3,2,10,76,33,061,45,77,26,123,42,81,03,189,33,82,02,188,,0*7F
$GLGSV,3,3,10,83,37,311,48,84,01,347,,,,,,,,0*75
$BDGSV,2,1,05,02,05,104,,05,18,122,40,07,18,037,,10,37,059,41,0*7F
$BDGSV,2,2,05,14,60,076,46,,,,,,,,,,,,0*41

A.10 HDT - Heading, True

Syntax

$--HDT,x.x,T*hh<CR><LF>

Description of fields

Field	Description
$--HDT	Header including talker ID
x.x	Heading, degrees True
T	Fixed text T for true north
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

Standard Talker ID
$GNHDT,11.4,T, 00*4B

A.11 LLK - Leica Local Position and GDOP

Syntax

$--LLK,hhmmss.ss,mmddyy,eeeeee.eee,M,nnnnnn.nnn,M,x,xx,x.x,x.x,M*hh<CR><LF>

Description of fields

Field	Description
$--LLK	Header including talker ID
hhmmss.ss	UTC time of position
mmddyy	UTC date
eeeeee.eee	Grid Easting in metres
M	Units of grid Easting as fixed text M
nnnnnn.nnn	Grid Northing in metres
M	Units of grid Northing as fixed text M
x	Position quality 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed 5 = Real-time position, float
xx	Number of satellites in use. For $GNLLK messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
x.x	GDOP
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported.
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

For NMEA v4.0:

Standard Talker ID

$GNLLK,113616.00,041006,764413.024,M,252946.774,M,3,12,1.7,1171.279,M*0F
$GPLLK,113616.00,041006,,,,,,08,,,*57
$GLLLK,113616.00,041006,,,,,,04,,,*47

User-defined Talker ID = GN

$GNLLK,113806.00,041006,764413.021,M,252946.772,M,3,13,1.4,1171.283,M*04

For NMEA v4.1:

$GNLLK,113616.00,041006,764413.024,M,252946.774,M,3,12,1.7,1171.279,M*0F

A.12 LLQ - Leica Local Position and Quality

Syntax

$--LLQ,hhmmss.ss,mmddyy,eeeeee.eee,M,nnnnnn.nnn,M,x,xx,x.x,x.x,M*hh<CR><LF>

Description of fields

Field	Description
$--LLQ	Header including talker ID
hhmmss.ss	UTC time of position
mmddyy	UTC date
eeeeee.eee	Grid Easting in metres
M	Units of grid Easting as fixed text M
nnnnnn.nnn	Grid Northing in metres
M	Units of grid Northing as fixed text M
x	Position quality 0 = Fix not available or invalid 1 = No real-time position, navigation fix 2 = Real-time position, ambiguities not fixed 3 = Real-time position, ambiguities fixed 5 = Real-time position, float
xx	Number of satellites in use. For $GNLLQ messages: The combined GPS, GLONASS, Galileo and BeiDou satellites used in the position.
x.x	Coordinate quality in metres
x.x	Altitude of position marker above/below mean sea level in metres. If no orthometric height is available the local ellipsoidal height will be exported.
M	Units of altitude as fixed text M
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

For NMEA v4.0:

Standard Talker ID

$GNLLQ,113616.00,041006,764413.024,M,252946.774,M,3,12,0.010,1171.279,M*12
$GPLLQ,113616.00,041006,,,,,08,,,*4D
$GLLLQ,113616.00,041006,,,,,04,,,*5D

User-defined Talker ID = GN

$GNLLQ,113806.00,041006,764413.021,M,252946.772,M,3,13,0.010,1171.283,M*1A

For NMEA v4.1:

$GNLLQ,113616.00,041006,764413.024,M,252946.774,M,3,12,0.010,1171.279,M*12

Syntax

$--RMC,hhmmss.ss,A,llll.ll,a,yyyyy.yy,a,x.x,x.x,xxxxxx,x.x,a,a*hh<CR><LF>

Description of fields

Field	Description
$--RMC	Header including talker ID
hhmmss.ss	UTC time of position fix
A	Status A = Data valid V = Navigation instrument warning
llll.ll	Latitude (WGS 1984)
a	Hemisphere, North or South
yyyyy.yy	Longitude (WGS 1984)
a	East or West
x.x	Speed over ground in knots
x.x	Course over ground in degrees
xxxxxx	Date: ddmmyy
x.x	Magnetic variation in degrees
a	East or West
a*hh	Mode Indicator A = Autonomous mode D = Differential mode N = Data not valid
<CR>	Carriage Return
<LF>	Line Feed

Examples

Standard Talker ID

$GNRMC,113616.00,A,4724.5248557,N,00937.1063064,E,0.01,11.43,100406,11.43,E,D*1C

User-defined Talker ID = GN

$GNRMC,113806.00,A,4724.5248547,N,00937.1063032,E,0.00,287.73,100406,287.73,E,D*10

A.14 VTG - Course Over Ground and Ground Speed

Syntax

$--VTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>

Description of fields

Field	Description
$--VTG	Header including talker ID
x.x	Course over ground in degrees true north, 0.0 to 359.9
T	Fixed text T for true north
x.x	Course over ground in degrees magnetic North, 0.0 to 359.9
M	Fixed text M for magnetic North
x.x	Speed over ground in knots
N	Fixed text N for knots
x.x	Speed over ground in km/h
K	Fixed text K for km/h
a	Mode Indicator A = Autonomous mode D = Differential mode N = Data not valid
*hh	Checksum
<CR>	**C**arriage **R**eturn
<LF>	**L**ine **F**eed

Examples

Standard Talker ID
$GNVTG,11.4285,T,11.4285,M,0.007,N,0.013,K,D*3D
User-defined Talker ID = GN
$GNVTG,287.7273,T,287.7273,M,0.002,N,0.004,K,D*3E

A.15 ZDA - Time and Date

Syntax

$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx*hh‹CR›‹LF›

Description of fields

Field	Description
$--ZDA	Header including talker ID
hhmmss.ss	UTC time
xx	UTC day, 01 to 31
xx	UTC month, 01 to 12
xxxx	UTC year
xx	Local zone description in hours, 00 to ±13
xx	Local zone description in minutes, 00 to +59
*hh	Checksum
‹CR›	**C**arriage **R**eturn
‹LF›	**L**ine **F**eed

This message is given high priority and is output as soon as it is created. Latency is therefore reduced to a minimum.

Examples

Standard Talker ID
$GPZDA,091039.00,01,10,2003,-02,00*4B
User-defined Talker ID = GN
$GNZDA,113806.00,10,04,2006,02,00*76

Appendix B ORP – Orientation and Position

Description

This proprietary Leica message provides the current Position and Quality in either Geodetic or Grid coordinates for one or two antennas plus the resulting orientation.

☞ Information regarding the second antenna is not applicable for the iCON gps 60 SmartAntenna.

Access

Select **Settings** › **Tools** › **NMEA Output**. Toggle to **Edit** for **NMEA Out**. ORP is available on the second page of the wizard

Description of fields

Message type	Format	Description
RESPONSE:	$PLEIR,	Header, message sent from instrument
Position and Quality	ORP,	Message Identifier
	xxxx,	ControlType[1]
	x,	Position Format[2]
	The following block is available if **Control Type** = **1** or = **2** (Single or Dual GNSS)	
	x,	Solution Type Flag - 1st Antenna[3]
	If Solution Type Flag - 1st Antenna = 0 (not computed yet) and = *4* (not used)	
	hhmmss.ss,	UTC time
	ddmmyy,	UTC date
	xx,	Latency[4] [milliseconds]
	xx.xx,	Quality Latitude/Northing [metres]
	xx.xx,	Quality Longitude/Easting [metres]
	xx.xx,	Quality Height [metres]
	xx.xx,	GDOP – Value for first Antenna
	x,	Number of Satellites used in Computation (GPS)
	x,	Number of Satellites used in Computation (GG)
	If Position Format = 0 (Geodetic) the following block is present:	
	llll.ll,	Latitude (+: North -: South)
	yyyyy.yy,	Longitude (+: East -: West)
	xxxx.xxxx,	Altitude of position marker[5] [metres]
	If Position Format = 1 (Grid) the following block is present:	
	xxxx.xxxx,	Grid Northing [metres]
	xxxx.xxxx,	Grid Easting [metres]
	xxxx.xxxx,	Altitude of position marker [metres]
	x,	Height type[6]

Message type	Format	Description
	The following block is only available if **Control Type** = **2** (Dual GNSS)	
	x,	Solution Type Flag - 2nd antenna[3]
	If Solution Type Flag - 2nd Antenna = 0 (not computed yet) and = 4 (not used)	
	hhmmss.ss,	UTC time
	ddmmyy,	UTC date
	xx,	Latency[4] [milliseconds]
	xx.xx,	Quality Latitude/Northing [metres]
	xx.xx,	Quality Longitude/Easting [metres]
	xx.xx,	Quality Height [metres]
	If Position Format = 0 (Geodetic) the following block is present:	
	llll.ll,	Latitude (+: North -: South)
	yyyyy.yy,	Longitude (+: East -: West)
	xxxx.xxxx,	Altitude of position marker[5] [metres]
	If Position Format = 1 (Grid) the following block is present:	
	xxxx.xxxx,	Grid Northing [metres]
	xxxx.xxxx,	Grid Easting [metres]
	xxxx.xxxx,	Altitude of position marker [metres]
	x,	Height type[6]
	The following block is only available if **Control Type** = **3**	
	hhmmss.ss,	UTC time
	ddmmyy,	UTC date
	xx,	Latency[4] [milliseconds]
	xxxx.xxxx,	Orientation Angle[7] [degrees], 0.0° to 359.9°
	xx.xx,	Quality of calculated Orientation [degrees]
	*hh	Checksum
	<CR>	**C**arriage **R**eturn
	<LF>	**L**ine **F**eed

1 Control Type
1: Antenna1 Position Information
2: Antenna1 and Antenna2 Information
3: Antenna1 and Antenna2 Information + Orientation

2 Coordinate System
0: WGS Geodetic
1: Local Grid

3 Position
0: Computed Position not yet available
1: Differential code Position
2: Differential phase Position
3: Non-differential Position
4: Not used

4 Latency given is defined as the difference in time between the UTC of the measurements used in the computation and the UTC of the first Message byte sent out the instrument port.

5 Ellipsoidal height is forced for Geodetic coordinates.
Orthometric height is forced for Grid coordinates.

6 Height
0: Ellipsoidal height
1: Orthometric height

7 Orientation is only available if requested coordinate format is Local Grid.

Example

$PLEIR,ORP,3,1,2,084709.25,310713,50,0.006,0.005,0.016,1.847,5,7,5250781.241
,546672.161,371.528,1,254,084709.25,310713,100,0.005,0.004,0.012,5250781.2
77,546671.390,371.497,1,084709.25,310713,100,272.683,0.592*23

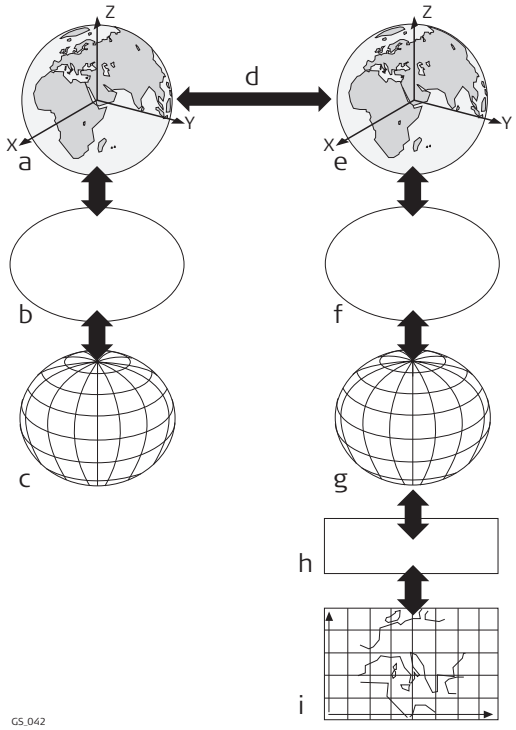
Appendix C Glossary

C.1 C

Coordinate system - elements

The five elements which define a coordinate system are:

- a transformation
- a projection
- an ellipsoid
- a geoid model
- a **C**ountry **S**pecific **C**oordinate **S**ystem model



a) WGS 1984 cartesian: X, Y, Z
b) WGS 1984 ellipsoid
c) WGS 1984 geodetic: Latitude, longitude, ellipsoidal height
d) 7 parameter transformation: dX, dY, dZ, rx, ry, rz, scale
e) Local cartesian: X, Y, Z
f) Local ellipsoid
g) Local geodetic: Latitude, longitude, ellipsoidal height
h) Local projection
i) Local grid: Easting, Northing, orthometric height

All these elements can be specified when creating a coordinate system.

CSCS model (*.ccg)

Description

Country **S**pecific **C**oordinate **S**ystem models

- are tables of correction values to convert coordinates directly from WGS 1984 to local grid without the need of transformation parameters.
- take the distortions of the mapping system into account.
- are an addition to an already defined coordinate system.

Types of CSCS models

The correction values of a CSCS model can be applied at different stages in the coordinate conversion process. Depending on this stage, a CSCS model works differently. Three types of CSCS models are supported. Their conversion process is as explained in

the following table. Any suitable geoid model can be combined with a geodetic CSCS model.

Type	Description
Grid	1 Determination of preliminary grid coordinates by applying the specified transformation, ellipsoid and map projection. 2 Determination of the final local grid coordinates by applying a shift in Easting and Northing interpolated in the grid file of the CSCS model.
Cartesian	1 Performing the specified transformation. 2 Determination of local cartesian coordinates by applying a 3D shift interpolated in the grid file of the CSCS model. 3 Determination of the final local grid coordinates by applying the specified local ellipsoid and map projection.
Geodetic	1 Determination of local geodetic coordinates by applying a correction in latitude and longitude interpolated from the file of the CSCS model. 2 Determination of the final local grid coordinates by applying the local map projection. ☞ Using a geodetic CSCS model excludes the use of a transformation in a coordinate system.

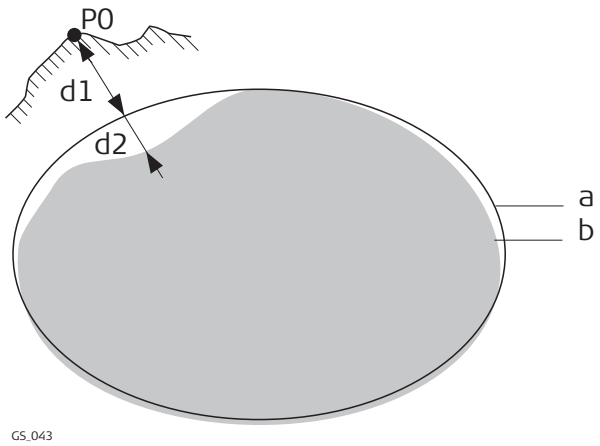
C.2 G

Geoid model

Description

GPS operates on the WGS 1984 ellipsoid and all heights obtained by measuring baselines are ellipsoidal heights. Existing heights are usually orthometric heights, also called height above the geoid, height above mean sea level or levelled height. The mean sea level corresponds to a surface known as the geoid. The relation between ellipsoidal height and orthometric height is

Orthometric Height = Ellipsoidal Height - Geoid Separation N



a WGS 1984 ellipsoid
b Geoid

P0 Measured point
d1 Ellipsoidal height
d2 Geoid separation N, is negative when the geoid is below the ellipsoid

N value and geoid model

The geoid separation (N value) is the distance between the geoid and the reference ellipsoid. It can refer to the WGS 1984 or to the local ellipsoid. It is not a constant except over maybe small flat areas such as 5 km x 5 km. Therefore it is necessary to model the N value to obtain accurate orthometric heights. The modelled N values form a geoid model for an area. With a geoid model attached to a coordinate system, N

values for the measured points can be determined. Ellipsoidal heights can be converted to orthometric heights and back.

Geoid models are an approximation of the N value. In terms of accuracy, they can vary considerably and global models in particular should be used with caution. If the accuracy of the geoid model is not known, it can be safer to use local control points with orthometric heights and apply a transformation to approximate the local geoid.

Geoid field file

The geoid separations in a geoid field file can be used in the field to change between ellipsoidal and orthometric heights.

Creation:	Export onto a USB Memory device or the internal memory of the instrument.
Extension:	*.grd

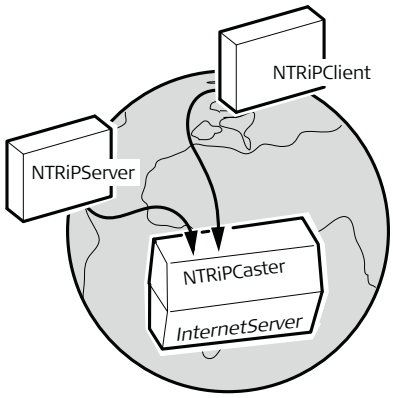
C.3 N

Ntrip

Networked **T**ransport of **R**TCM via **I**nternet **P**rotocol

- is a protocol streaming real-time corrections over the Internet.
- is a generic protocol based on the Hypertext Transfer Protocol HTTP/1.1.
- is used to send differential correction data or other kinds of streaming data to stationary or mobile users over the Internet. This process allows simultaneous computer, laptop, PDA, or instrument connections to a broadcasting host.
- supports wireless Internet access through mobile IP networks like digital cellular phones or modems.

The Ntrip Server could be the GPS instrument itself. This setup means the GPS instrument is both the Ntrip Source generating the real-time data and also the NTRIP Server transferring this data to the Ntrip Caster.



GS_044

Ntrip and its role in the Internet

Ntrip Caster

The Ntrip Caster

- is an Internet server handling various data streams to and from the Ntrip Servers and Ntrip Clients.
- checks the requests from Ntrip Clients and Ntrip Servers to see if they are registered to receive or provide real-time corrections.
- decides whether there is streaming data to be sent or to be received.

Ntrip Client

The Ntrip Client receives data streams. This setup could be, for example a real-time rover receiving real-time corrections.
In order to receive real-time corrections, the Ntrip Client must first send

- a user ID
- a password
- an identification name, the so-called Mountpoint, from which real-time corrections are to be received

to the Ntrip Caster.

Ntrip Server

The Ntrip Server transfers data streams.
In order to send real-time corrections, the Ntrip Server must first send

- a password
- an identification name, the so-called Mountpoint, where the real-time corrections come from

to the Ntrip Caster.
Before sending real-time corrections to the Ntrip Caster for the first time, a registration form must be completed. This form is available from the Ntrip Caster administration centre. Refer to the website of the Ntrip Caster administration centre.

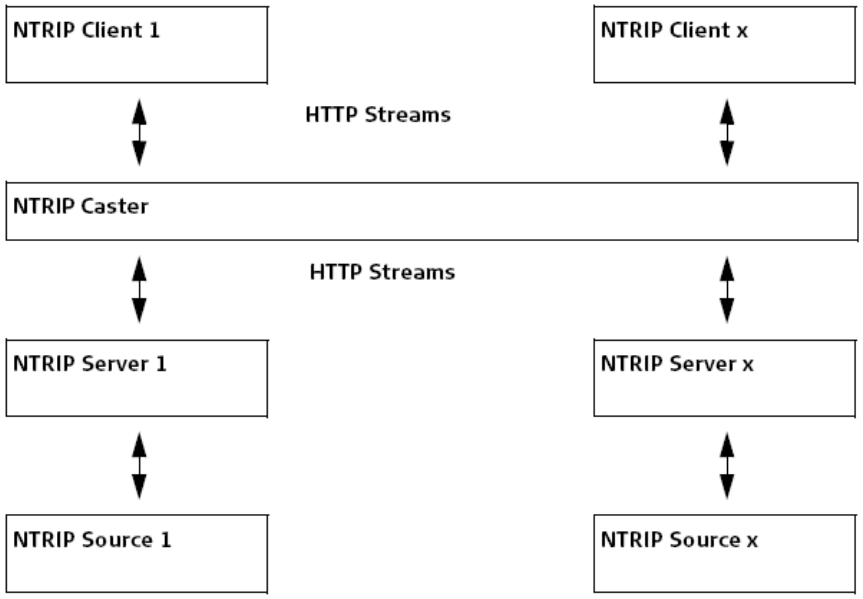
Ntrip Source

The Ntrip Source generates data streams. This setup could be base sending out real-time corrections.

Ntrip system components

Ntrip consists of three system components:

- Ntrip Clients
- Ntrip Servers
- Ntrip Caster



C.4 W

WGS 1984

WGS 1984 is the global geocentric datum to which all GPS positioning information is referred to.

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- when it has to be **right**

Leica Geosystems